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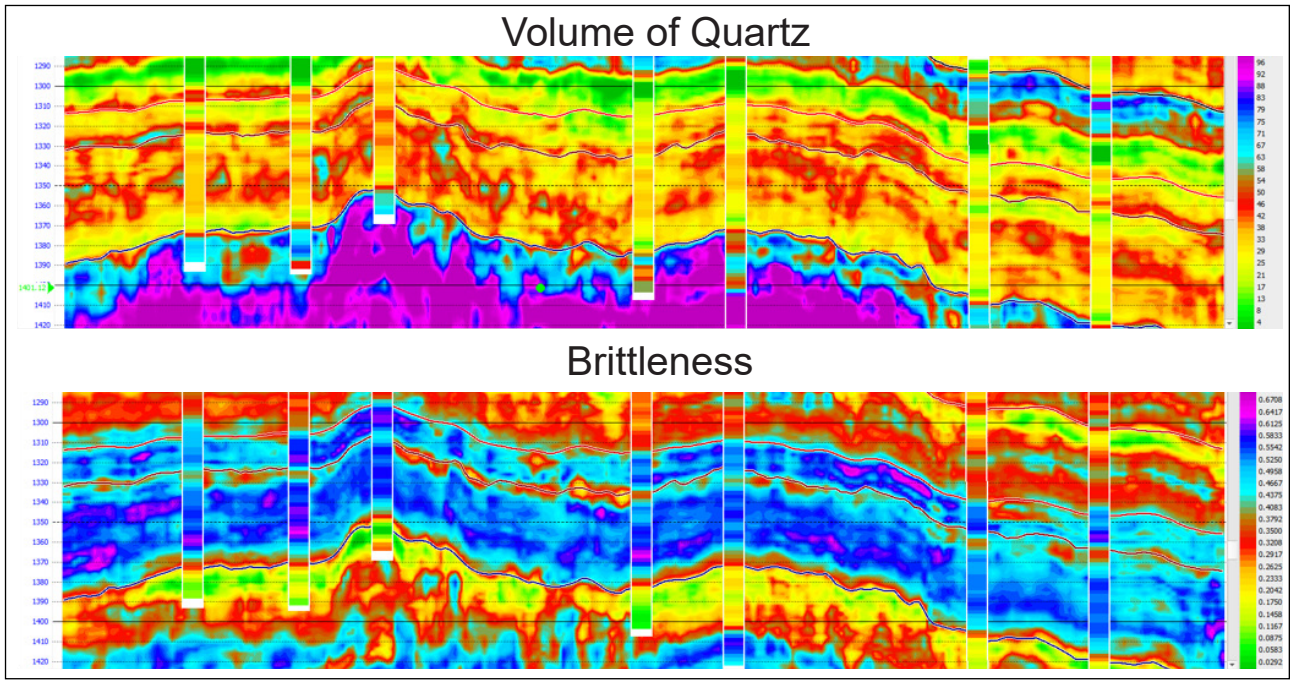
GeoAI

GeoAI : Revolutionizing Seismic Reservoir Characterization

GeoAI is an innovative approach to seismic reservoir characterization that simultaneously predicts multiple reservoir properties using a streamlined machine learning workflow. This method uses a rock physics driven machine learning technique, which is informed by rock physics theory and statistical simulations to generate synthetic data for a range of geological scenarios. By employing Convolutional Neural Networks (CNNs), GeoAI can efficiently estimate multiple rock property volumes with high detail and agreement to blind wells.



The natural gas Barnett Shale play. Volume of Quartz from the CNN (top) and Brittleness calculated from CNN estimated elastic properties (bottom).

Benefits

- Improve exploration success rate in challenging, low well-control areas.
- Overcome poor well data quality by using Rock Physics Modelling and synthetic well data generation.
- Integrate rock physics with machine learning, making geological interpretation more insightful.
- Estimate multiple rock and elastic volume properties with one model, reducing project turn-around time.
- Generate facies predictions and facies probability volumes, as well as a most probable class cube.
- Produce higher detail results than conventional inversion workflows can provide.

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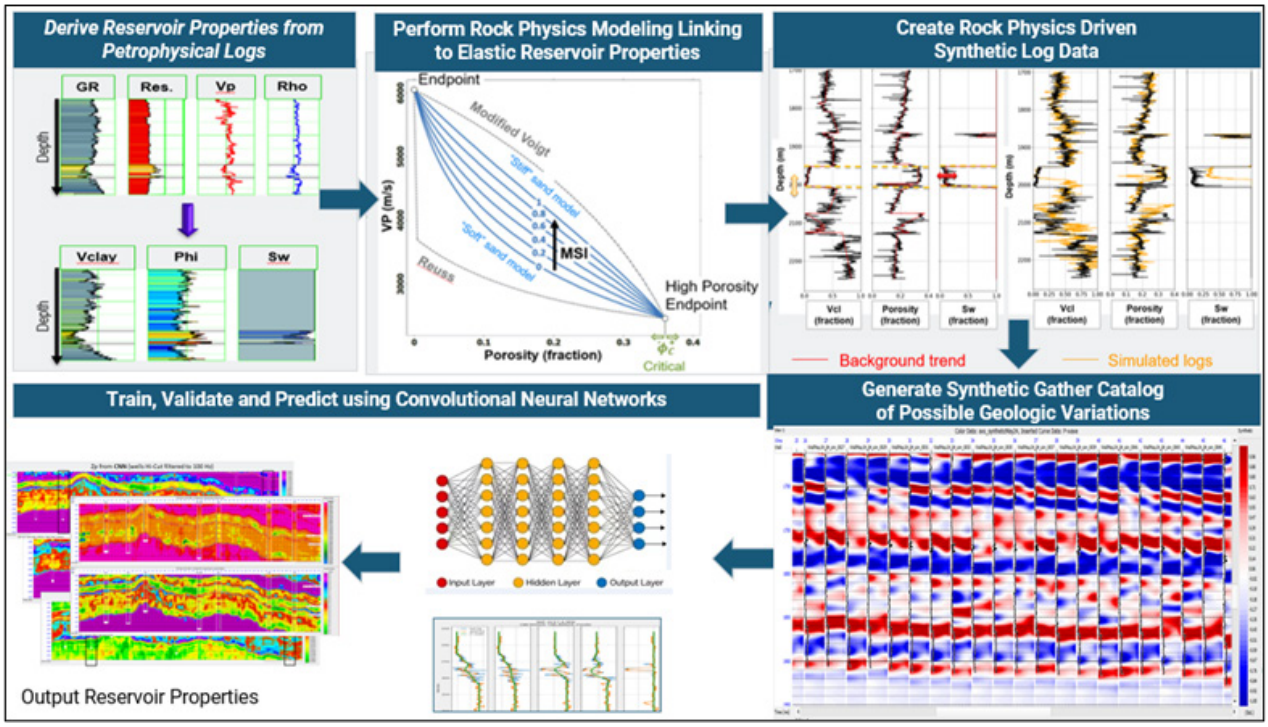
Workflow

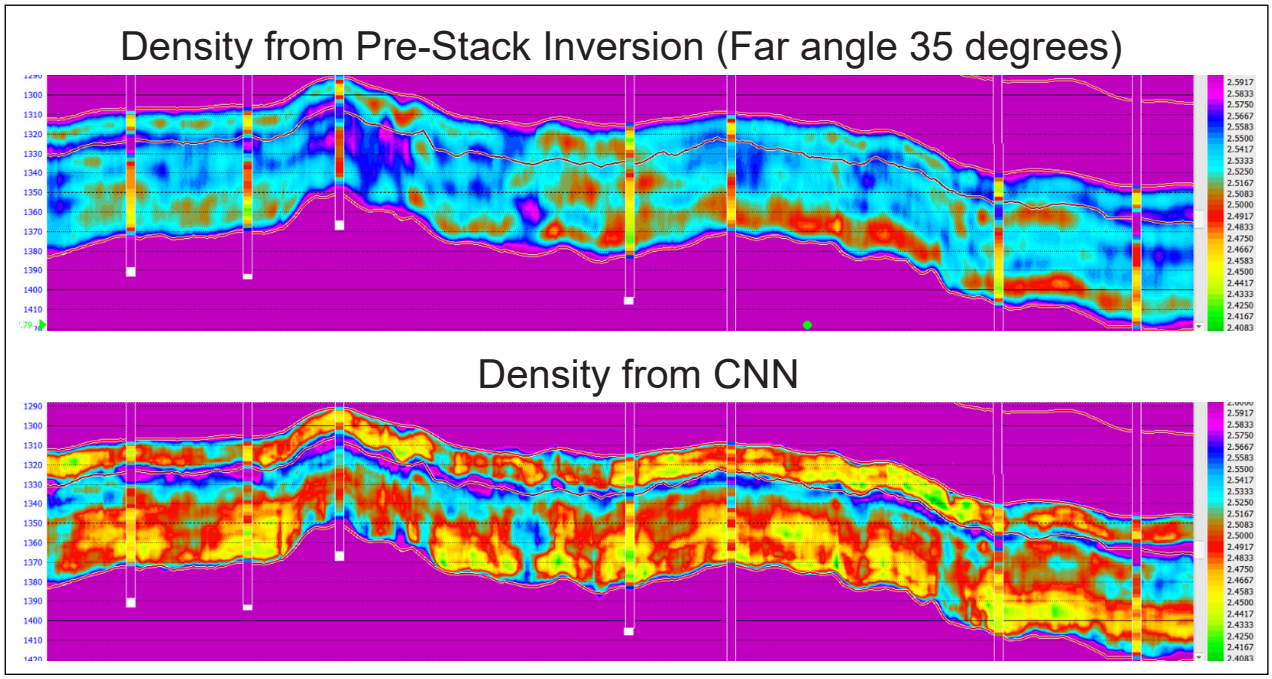


GeoAI workflow: generate synthetic training data based on Rock Physics modelling; create and validate machine learning models; predict reservoir properties as a result.

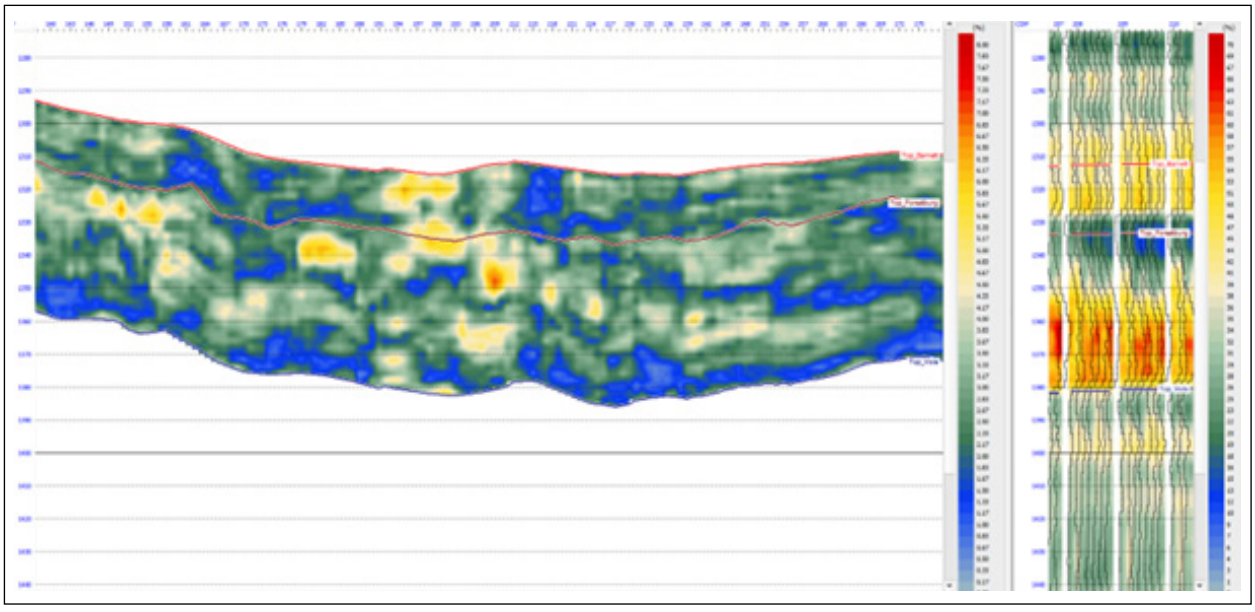
Functionality

- Synthetic well catalog workflow to generate well logs and synthetic gathers for training of deep learning models.
- Advanced rock physics modelling capabilities for clastics, unconventional and carbonate reservoirs.
- Blind well validation and jackknife validation provide error metrics and confidence levels of machine learning predictions.
- Transfer learning methodology updates the training model by incorporating real well control and leverages the model trained on rock-physics consistent synthetic data.
- Use of pre-stack seismic gathers to train and validate CNNs.
- Goodness-of-fit metrics to aid in the training model selection and evaluation.
- Confusion matrix analysis to model mis-fit metrics for classification studies.
- Uncertainty analysis volumes to access the variability and confidence in the predicted properties.

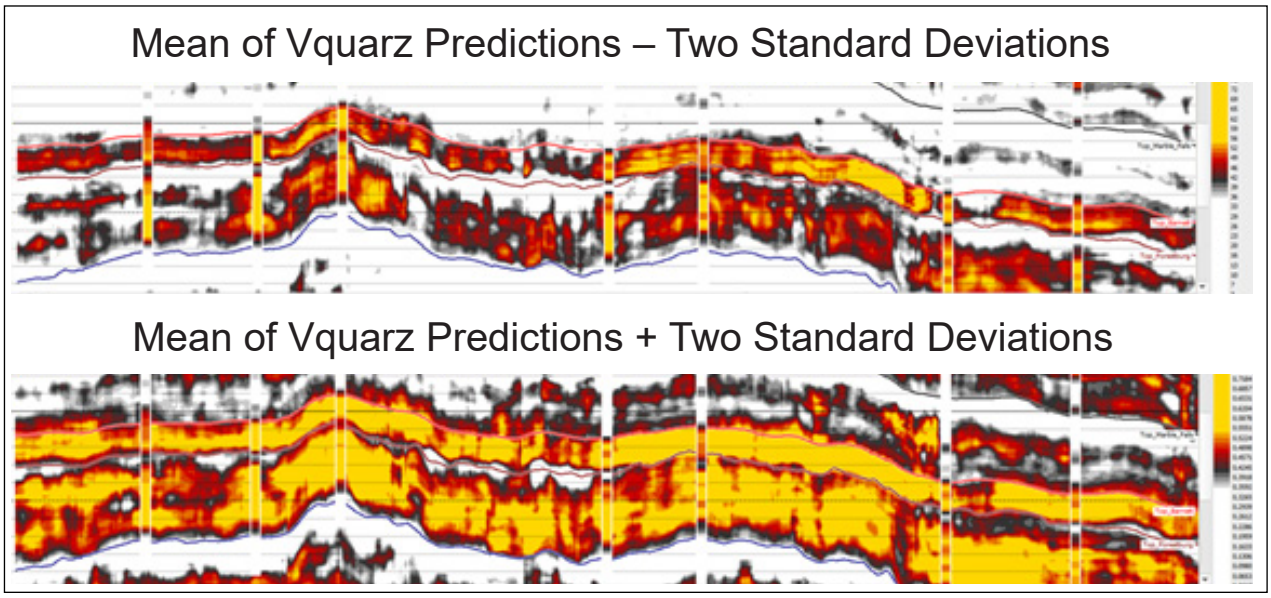
Results



Comparison of Density estimated from pre-stack inversion (top) and from the CNN (bottom). The wells contained in black are the blind wells. CNN estimate has higher detail, matches the well control better and displays higher lateral continuity.



Comparing standard deviation of Vquartz estimation (left) with model prediction variability gathers (right). The highlighted area reflects a larger standard deviation, indicating the high variability in the model's predictions, thus lower confidence.



Vquartz Comparison: Lower and Upper Bound Prediction.

Conclusion

GeoAI revolutionizes seismic reservoir characterization with its Rock physics-based Machine Learning approach, simplifying workflows with CNNs and improving accuracy, speed, and cost-effectiveness. By utilizing rock physics guidance and CNNs, GeoAI enhances Reservoir Characterization, enabling direct predictions of reservoir properties and facies . It can significantly help in adding a new dimension for seismic quantitative interpretation, by optimizing data extraction for greater efficiency and value addition.

Contact us to learn how GeoAI can help your organization achieve its reservoir characterization goals.