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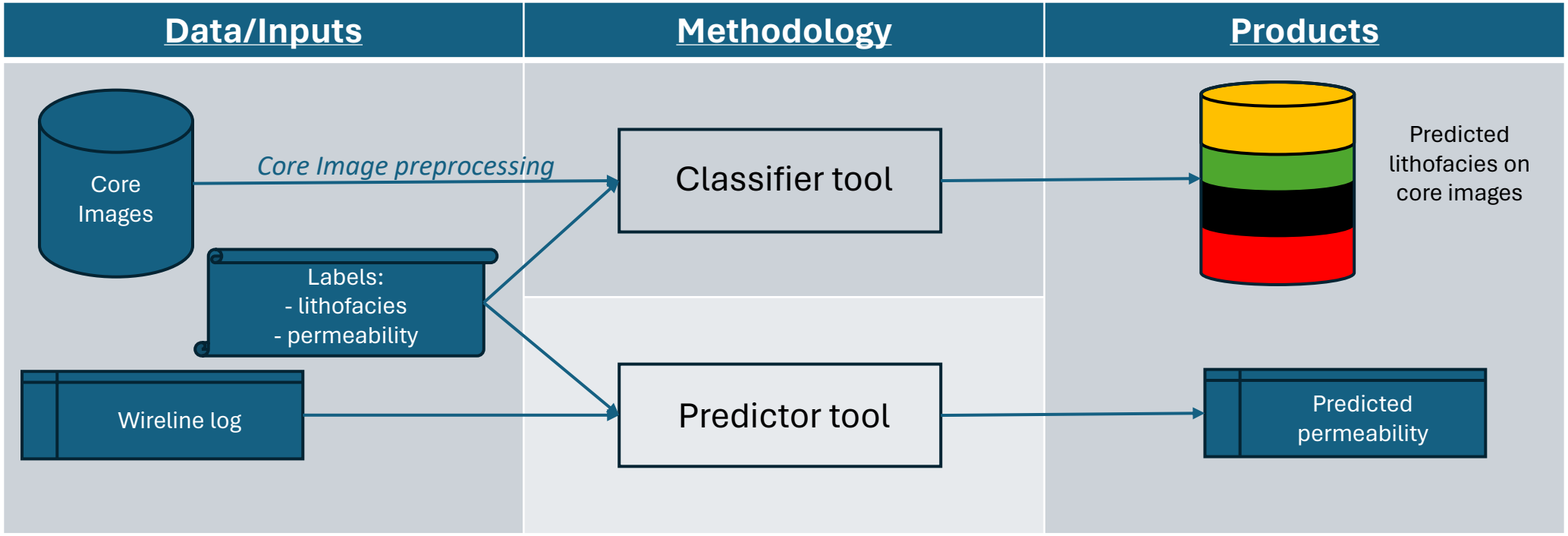
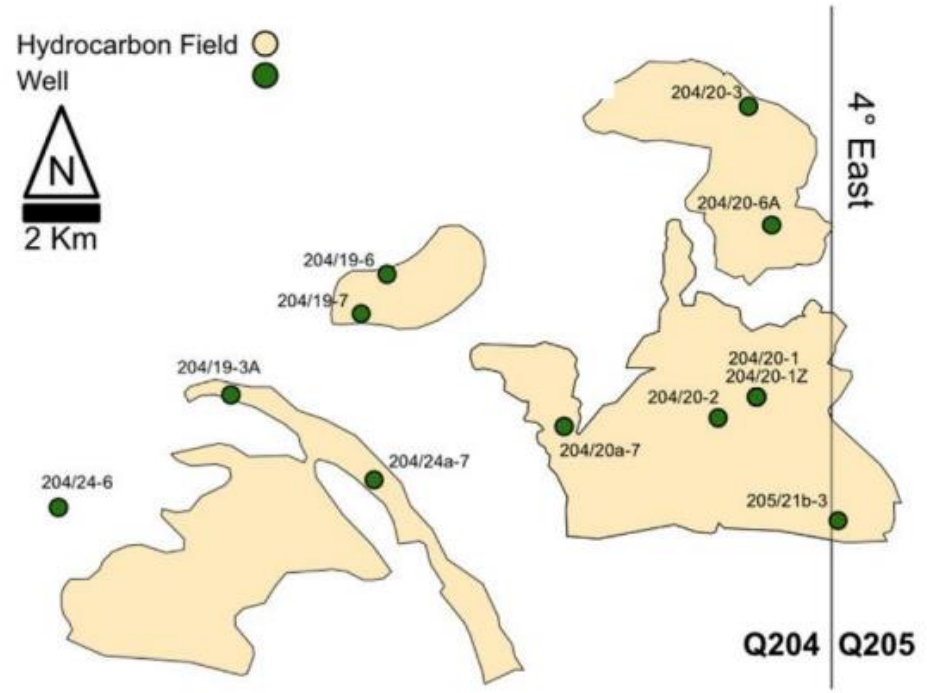
Arcadia Outline

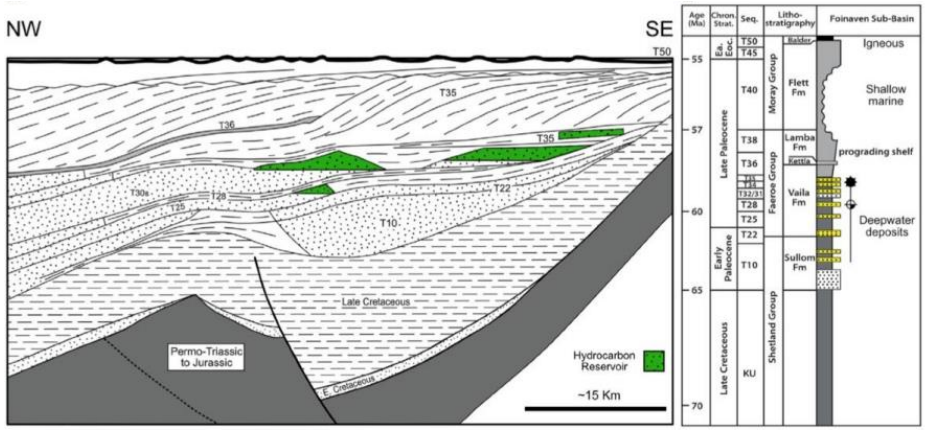
- Project Overview
- Geological Summary of Arcadia
- Permeability Prediction
- Core Image preprocessing
- Facies Classification
- Data Visualization
- Summary and Future Improvements

Project overview

- Project Aim:
  to produce a working GeoPredictor Tool to predict permeability and help interpretation new drilled well based on wireline log measurements and core images data.
- Deliverables:
  Lithofacies classifier, Permeability predictor, Visualization tool, documentations, report.



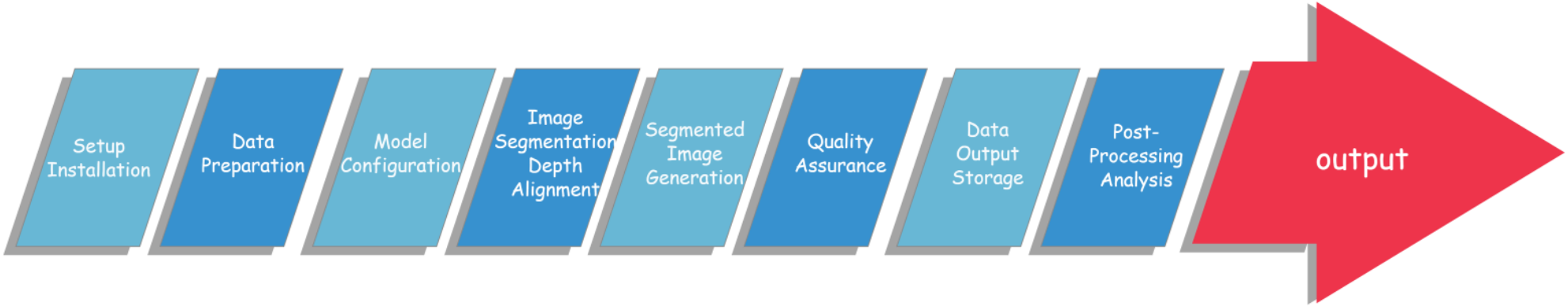




Geological Summary

- Our study focuses on Arcadia Oil field, it is the latest exploration area in the Avalon Basin
- The total area is about 300 sq.km with 10 producing wells and 1 non-producing well.
- The hydrocarbon reservoir comprises of neo-paleocene deep marine siliciclastic rocks, which was interpreted to be submarine fan turbidite product.
- Our evaluation will focus on the permeability prediction and facies classification

Data Processing Workflow



Analysis:

- Depth Registration Accuracy
- Segmented Image Processing
- Stratigraphic Sequence Revelation

Core Image preprocessing

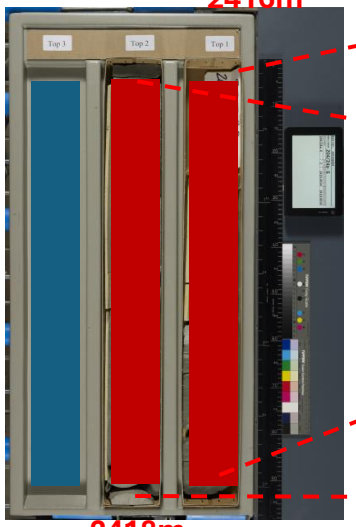
Example core box 1(204-24a-6)

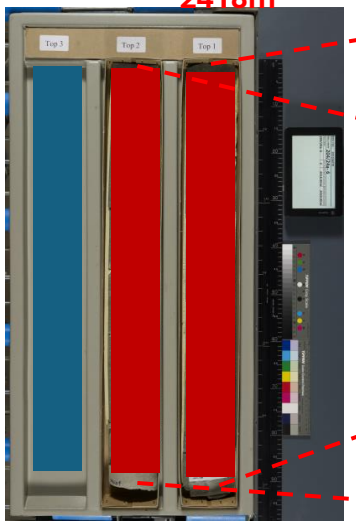
Example core box 2(204-24a-6)

empty tray

core

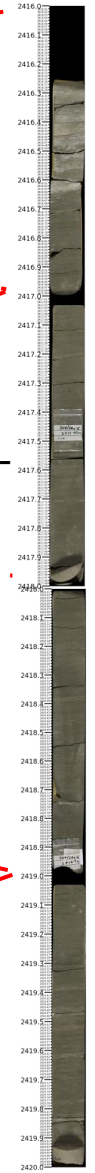
inference





Splice together depth-registered image

Result



depth-registered core image

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Permeability predictor

EDA and Preprocesing

- Missing values
- Substitute special characters.
- Geological relevance

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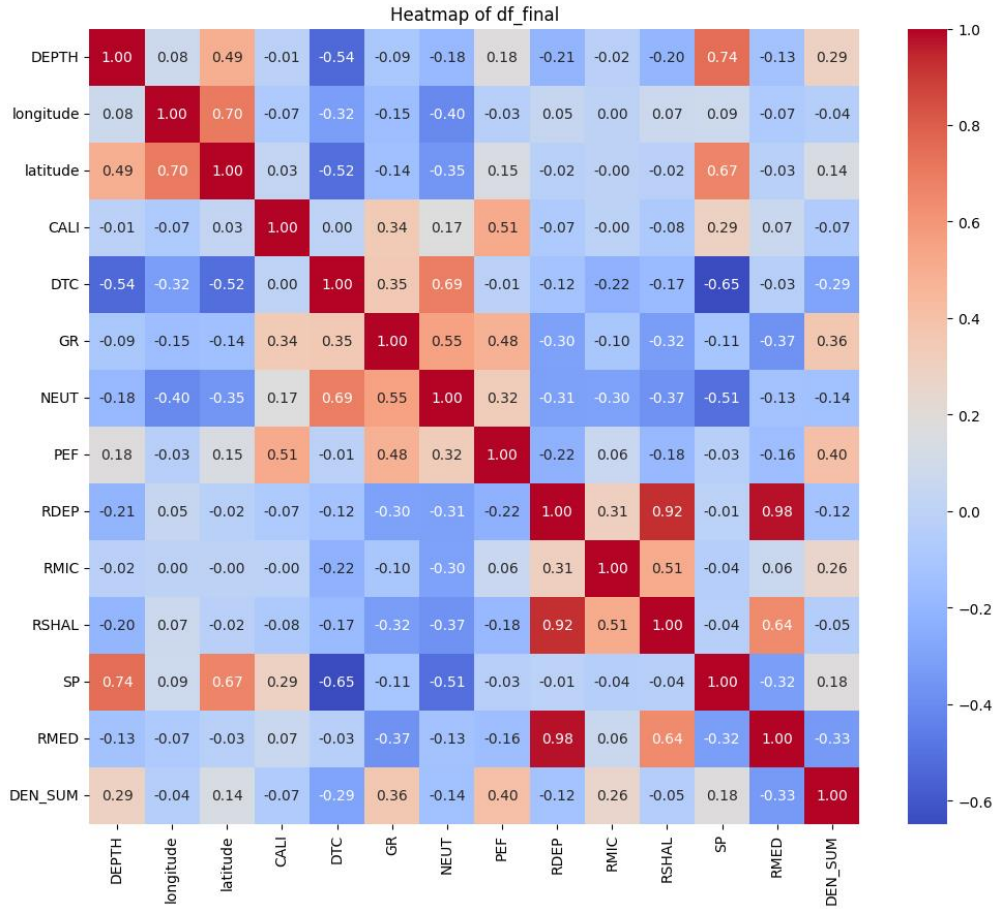
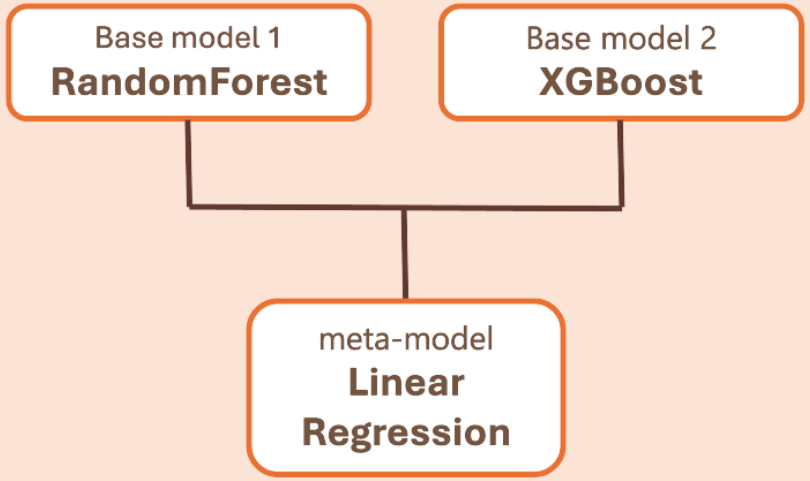
Permeability predictor

Feature Engineering



Best Algorithm:



- **Columns into consideration:**

DEPTH | latitude | POROSITY (HELIUM)

DEN_SUM (DENC+DENS) | DTC | PEF

GR (log_GR) | RDEP (log_RDEP)

Features are chose based on the geological properties and heatmap correlations.

- **Result:**

Validation Set	RMSE	371.7734972937151
	R^2	0.5479965292735106
Test Set	RMSE	305.18291493327513
	R^2	0.6231405218567553

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Permeability predictor

Summary

Key Summary

- Initial tried: KNN, SVM. But: high mean square error
- Hyperparameter tuning using GridSearchCV
- Use a stacked model to combine the predictions of RandomForest and XGBoost .

Future Improvements

- Using larger data sets
- Separate training and test sets by well to make predictions more effectively
- Include NEUT and LONG
- Deeper forests, Huber final estimator
- Wider Gridsearch

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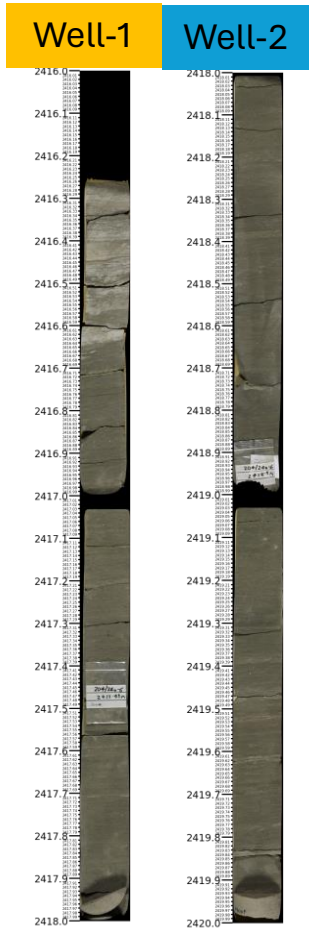
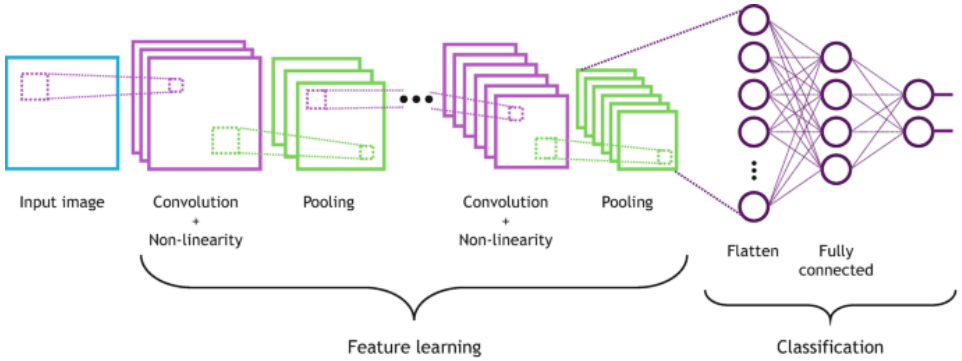
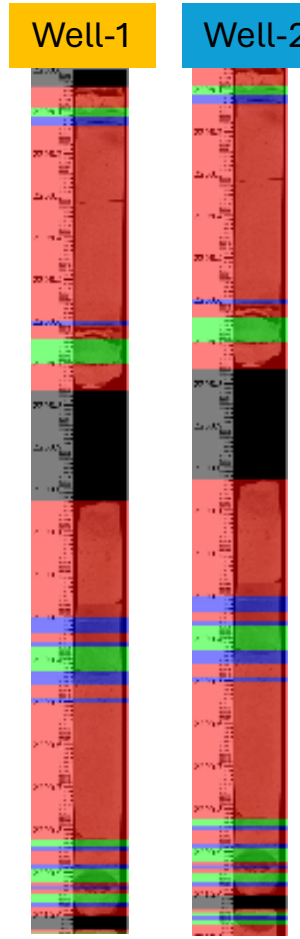
Classification of well core images

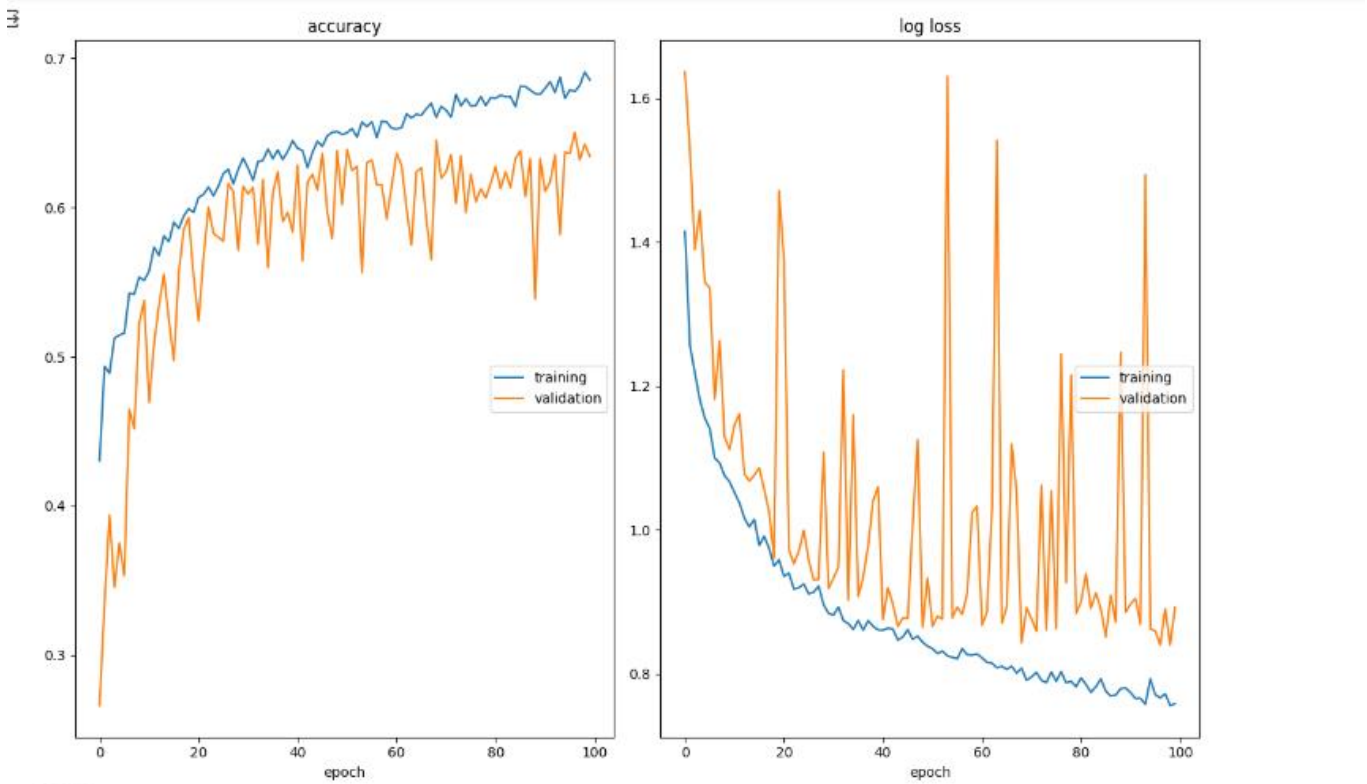






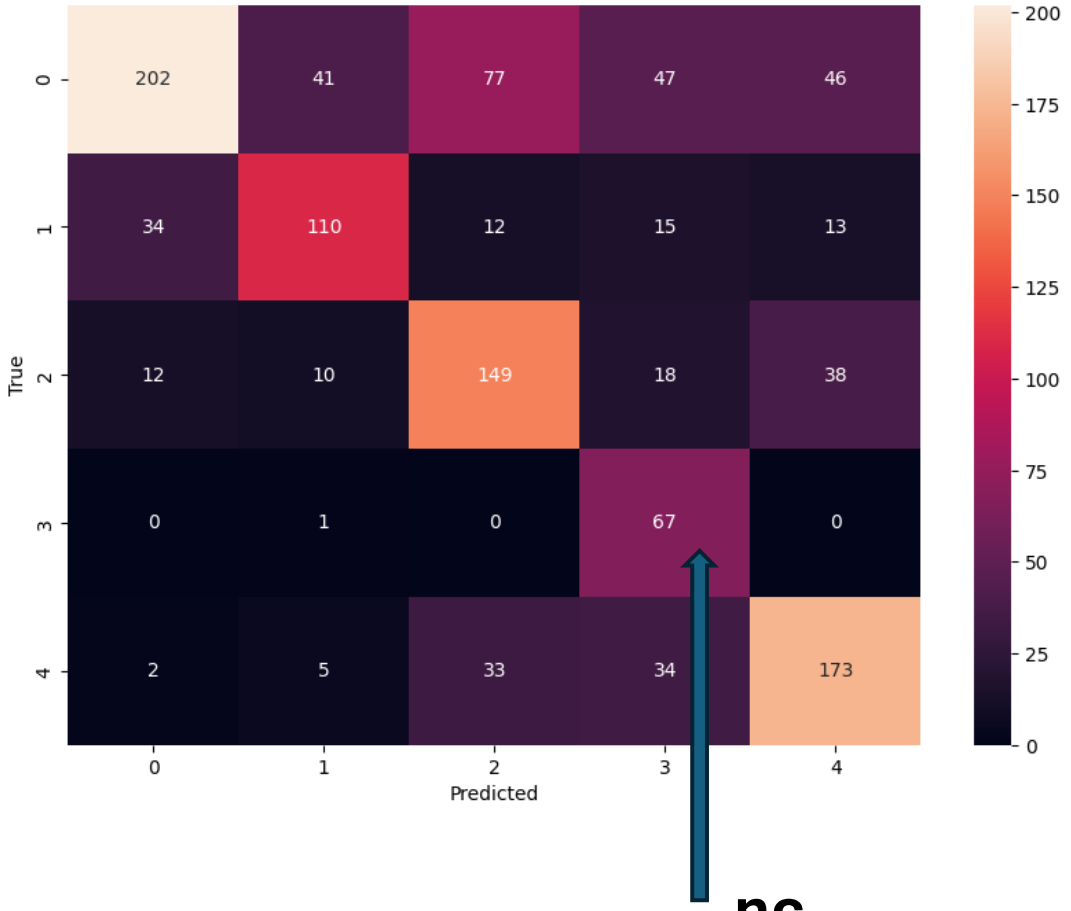
Classification of well core images

Classification of well core images




```
accuracy
        training         (min:    0.430, max:    0.691, cur:    0.686)
        validation       (min:    0.266, max:    0.650, cur:    0.634)
log loss
        training         (min:    0.756, max:    1.415, cur:    0.759)
        validation       (min:    0.840, max:    1.637, cur:    0.893)
```

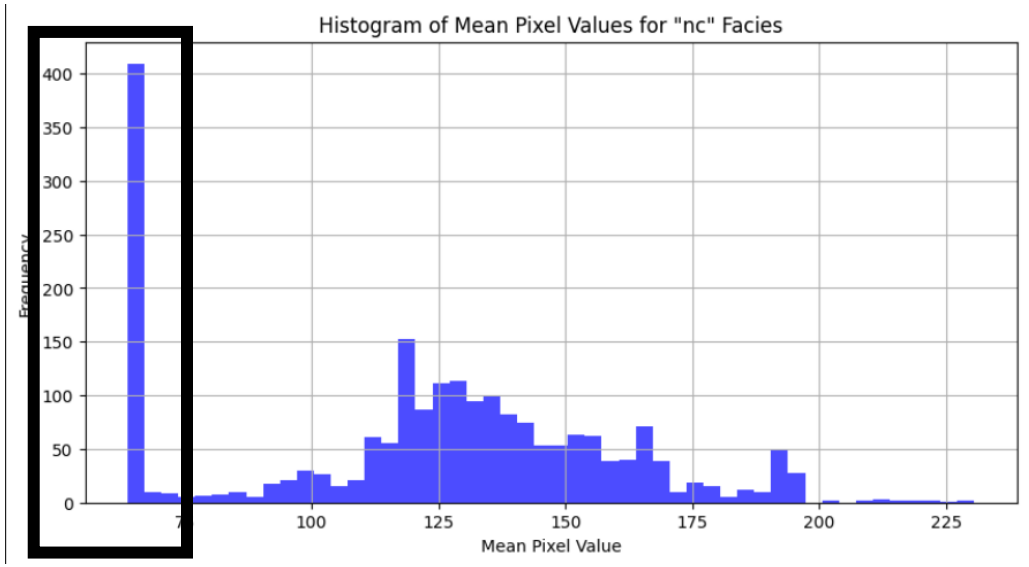
Classification of well core images



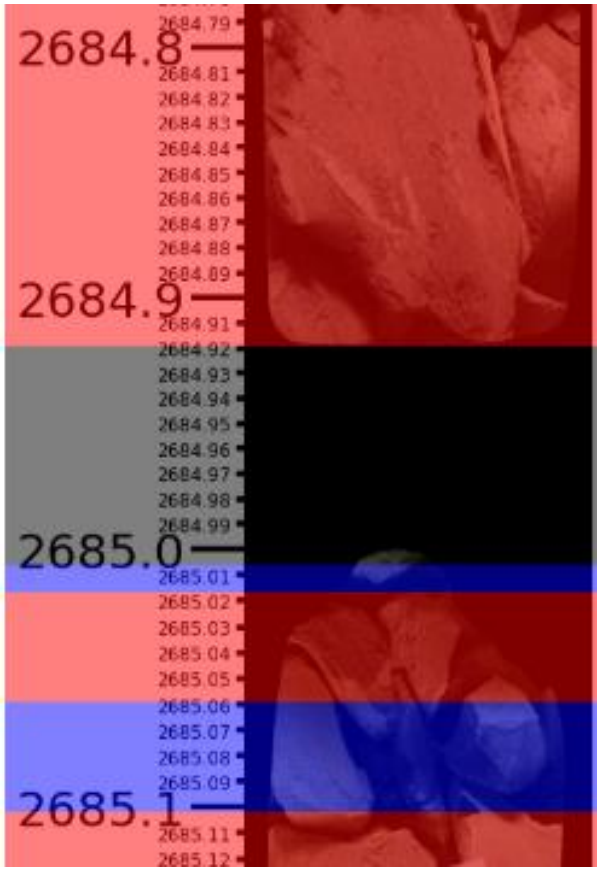
nc

```
facies_labels
```

```
{'is': 0, 'os': 1, 'sh': 2, 'nc': 3, 's': 4}
```



Classification of well core images



s : red with transparency
sh : green with transparency
nc : black with transparency
is : blue with transparency
os : yellow with transparency

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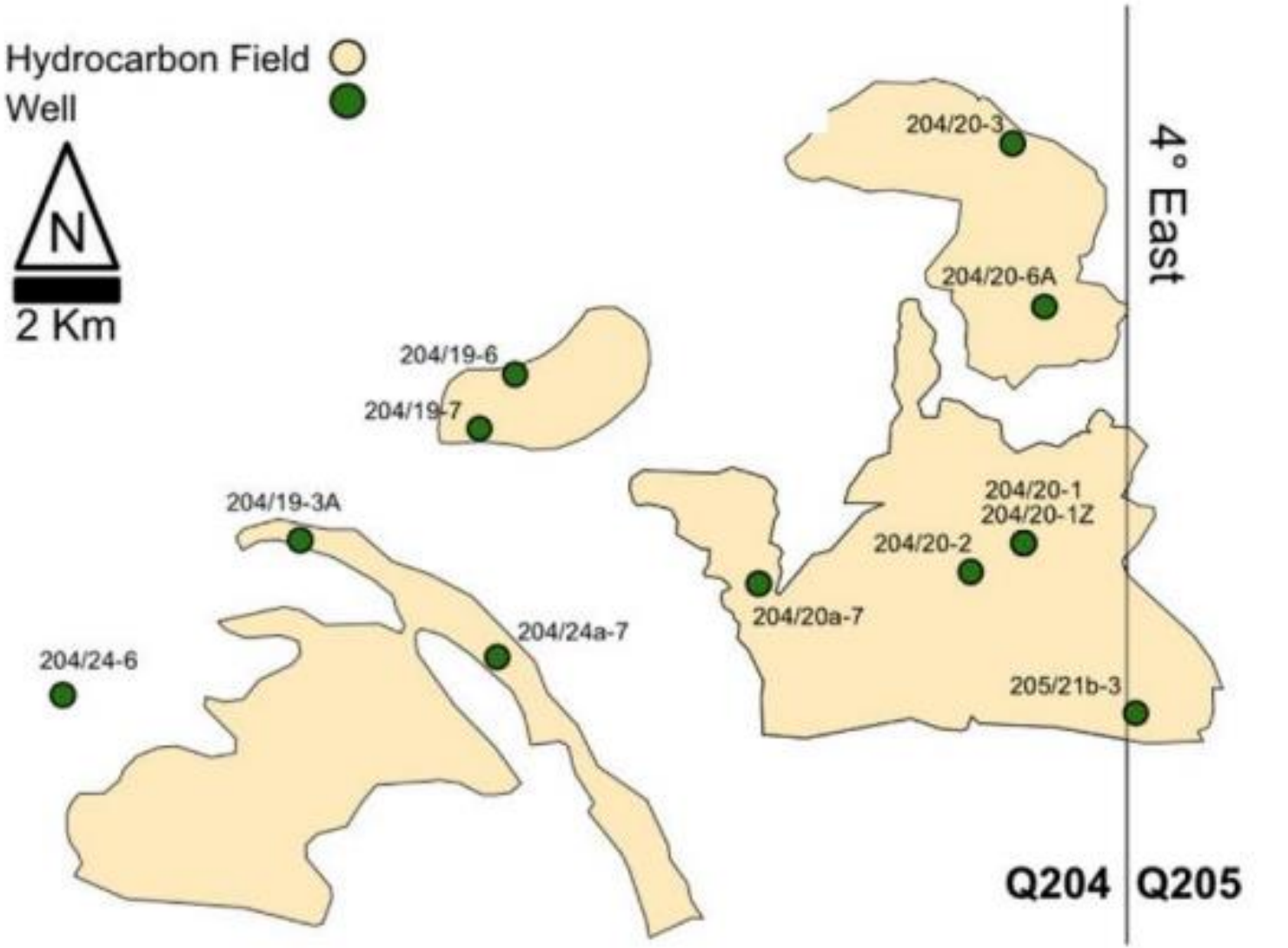
Visualization



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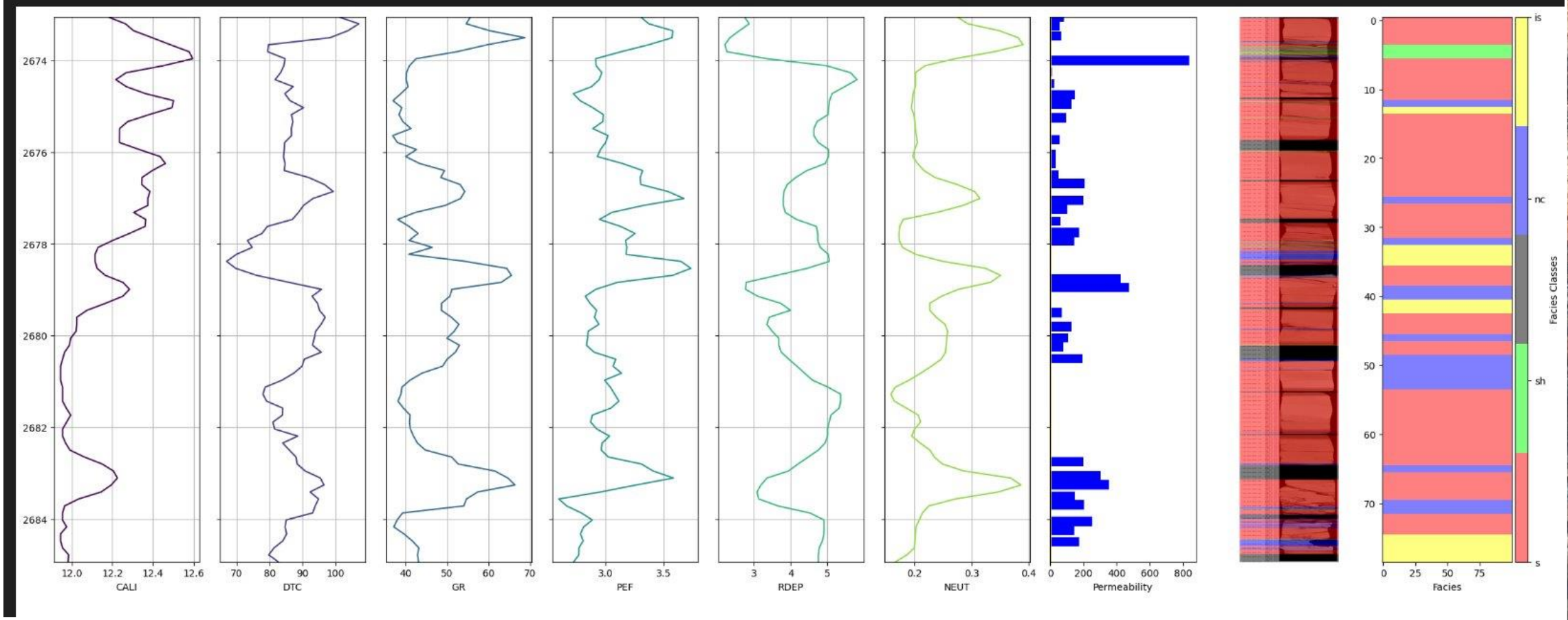
Visualiser – label vs predicted label

Select Well: 204_20_1Z

```
/tmp/ipykernel_629190/1396428162.py:108: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  permeability_filtered['PERMEABILITY (HORIZONTAL)\nKair\nmd'] = permeability_filtered['PERMEABILITY (HORIZONTAL)\nKair\nmd'].fillna(0)
```



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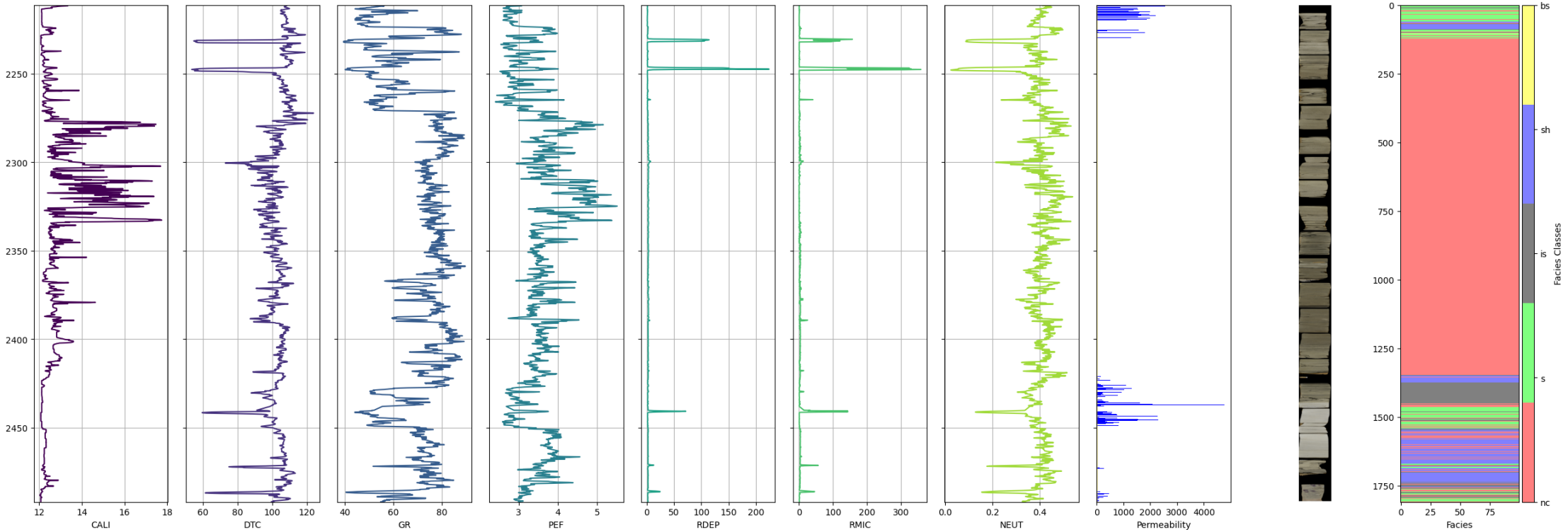
Visualiser – blind well (dummy data)



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Summary & Future Improvements

- The GeoPredictor Tool enhances Arcadia Field exploration by leveraging facies classification and permeability prediction with multiple log features and latitude, delivering reasonable accuracy and R-squared values.
- The classifier achieves 64% accuracy in lithofacies identification from core images, and the visualizer integrates these outputs to predict permeability and classify lithofacies in new wells.
- Future improvements include expanding datasets for permeability, integrating wireline logs for better lithofacies classification, and enhancing the visualizer to indicate potential hydrocarbon reservoirs.

Powerpoint background Images produced using Dall-E