The Illinois Basin has an excellent history of pilot- and demonstration-scale CO₂ injection projects, positioning it as a promising potential hub for carbon capture and storage (CCS). Since the presence of fractures increases the risk of an induced seismic response and CO₂ leakage, it is essential that these injection sites are properly characterized before project deployment. To address this challenge, this research project focuses on developing machine learning models that can efficiently and accurately infer the presence of fractures in geological formations.

The data labels were extracted through manual analysis of FMI logs, which provide high-resolution images by measuring rock resistivity. Various machine learning approaches including logistic regression, random forest, and XGBoost were implemented and evaluated. The best-performing model was a non-linear neural network that takes in various petrophysical and mineralogical feature data and outputs the probability that a fracture exists at certain depths.

The model achieved a 79% test accuracy and 54% test F1 score when trained on well VW1 and tested on well CCS1. Similarly, training on well CCS1 and testing on well VW1 yielded a 75% test accuracy and 50% test F1 score. While these results indicate that the current model’s performance is insufficient for practical fracture detection, they provide valuable insights for improvement.

Future work will involve exploring alternative feature combinations, incorporating data from additional wells, and employing more advanced machine learning models to build robust tools for fracture prediction that can be utilized within the scope of geoenergy projects.