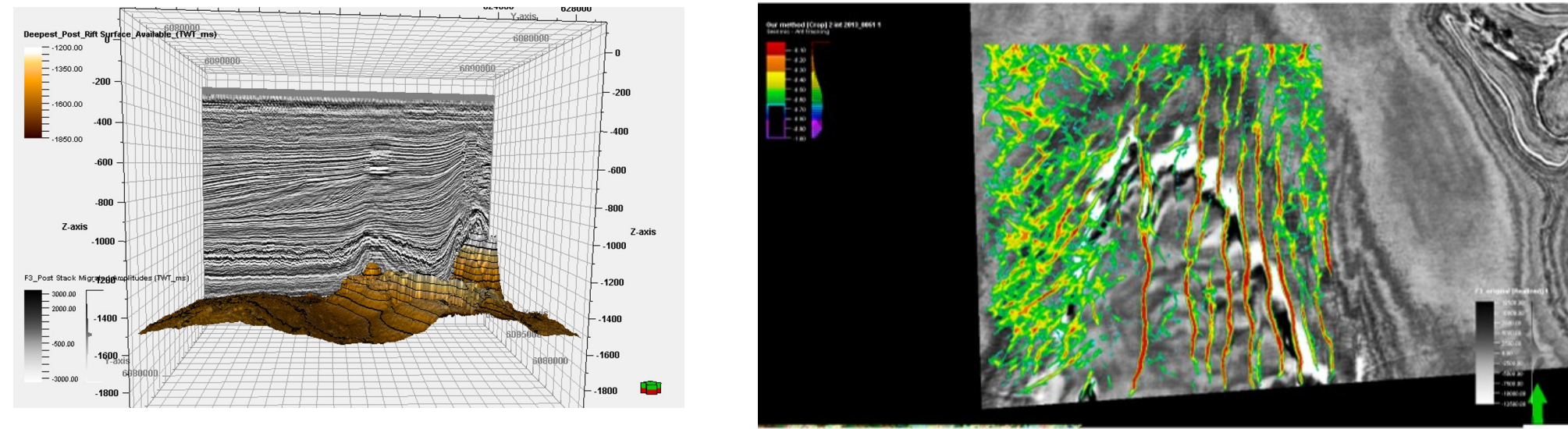


## Introduction:

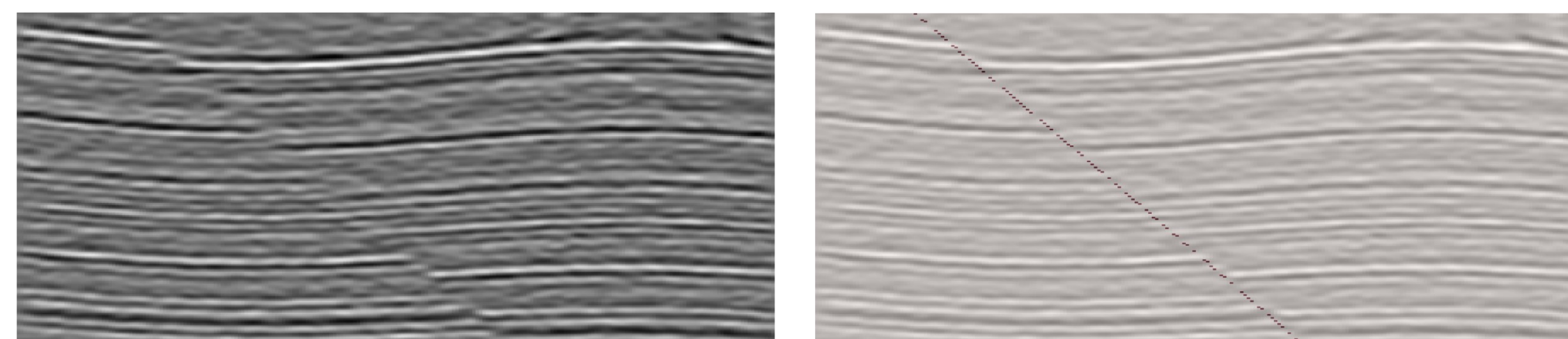
- Earth structural heterogeneities significantly impact the petroleum economy in both exploration and production projects.



- We propose an efficient and cost-effective architecture which uses Convolutional Neural Networks (CNNs) combined with Attention layers for detecting seismic structural heterogeneities.

- The model leverages synthetic data and applies transfer learning to train and fine-tune, addressing the challenge of limited annotated data availability.

Synthetic Data

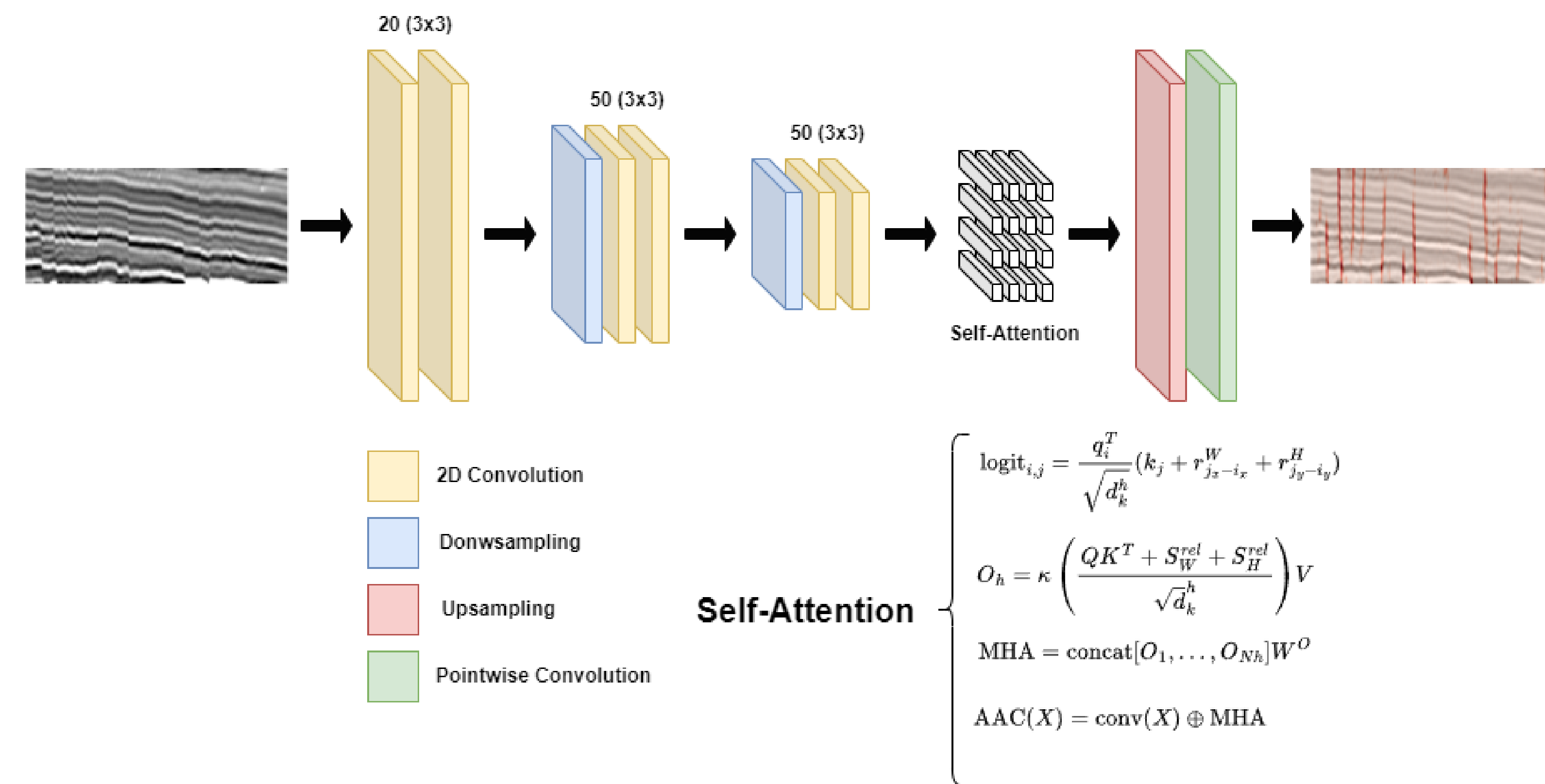


- The proposed model has half the parameters compared to state-of-the-art models and outperforms previous methods in Intersection over Union (IoU) by 0.6% and precision by 0.4%.

Model	IoU	Recall	Precision	F1
SE-NET (Ours)	0.712	0.968	0.662	0.78
Self-attention (Ours)	<b>0.912</b>	0.984	<b>0.957</b>	<b>0.97</b>
SVM [5]	0.572	0.966	0.60	0.78
MLP [5]	0.609	<b>0.997</b>	0.683	0.81
Fine Tuning [21]	0.554	0.949	0.564	0.70
GCN [20]	0.906	0.48	0.85	0.61
Transformer dual U-Net [26]	0.90	0.83	0.954	0.88

## Proposed Method:

- 4000 synthetic seismic images were generated using the IPF code from Hale. Images were divided into 44x44 pixel patches with confidence maps for heterogeneities and non-heterogeneities.
- The network architecture includes convolutional layers followed by self-attention blocks.
- The output assigns a probability for each pixel class (heterogeneities or non-heterogeneities).



- Real data from the F3 North Sea is preprocessed for transfer learning to address limitations of the synthetic dataset.
- Evaluation is done on the F3 dataset and New Zealand Great South Basin dataset, comparing results with state-of-the-art methods and geophysicist interpretations.

## Experiment:

- Results performed over the F3 Block PSTM at inline 120. Interesting observation suggestions on how different mechanisms of salt tectonics are related to the upward movement of gas, using structural paths to fill the traps, and generating bright spots. Blue arrows indicate these paths. White dotted lines suggest important rheological limits of layer-constrained faults and fractures.

