



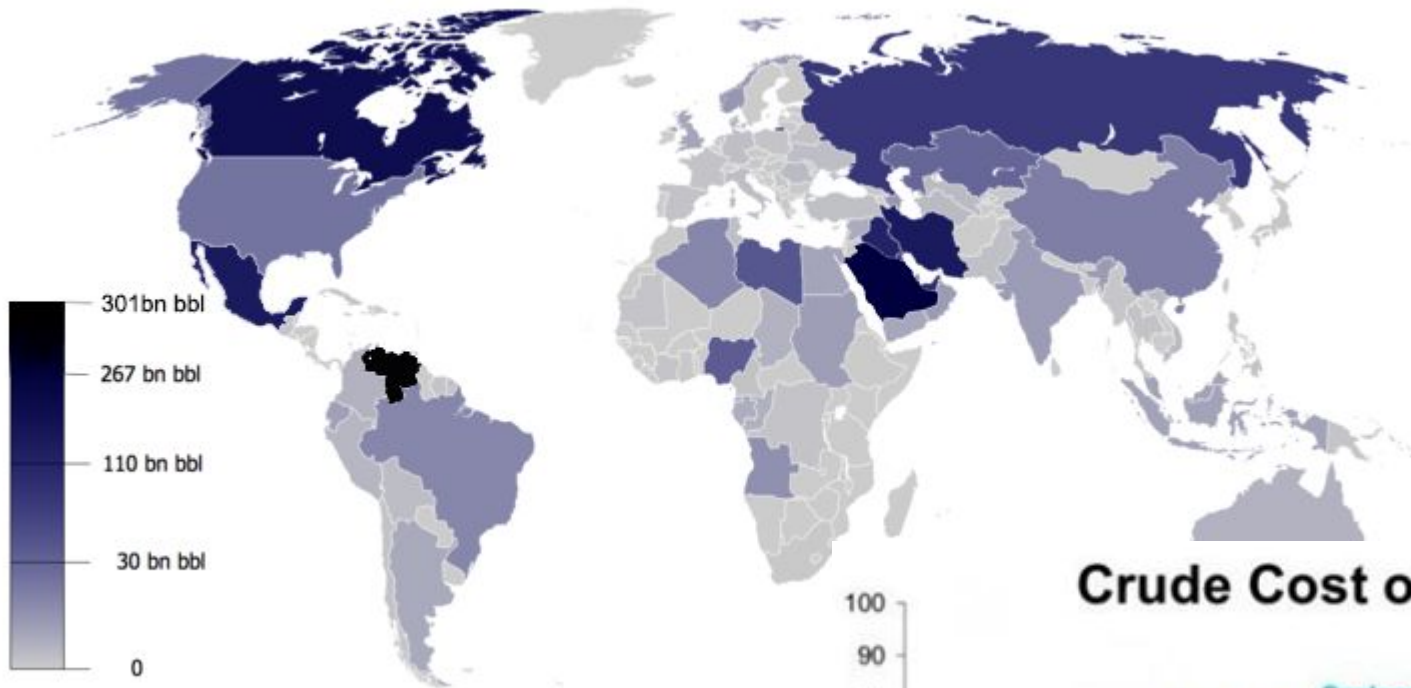
Deep^{*}light

VENTURES

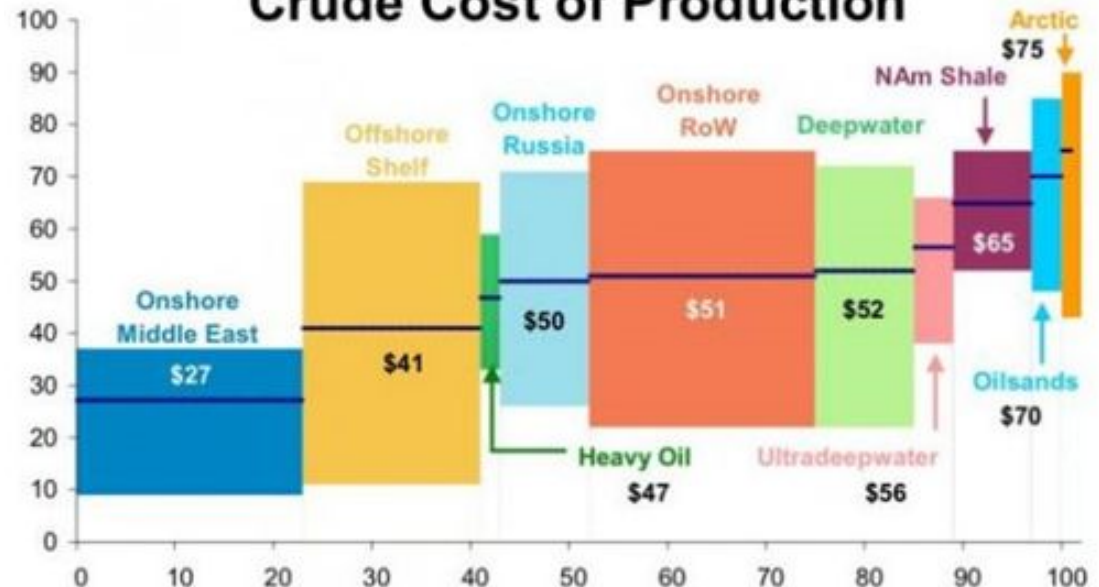
Research Plan: Machine Learning in Oil and Gas Industry

World hydrocarbon resources

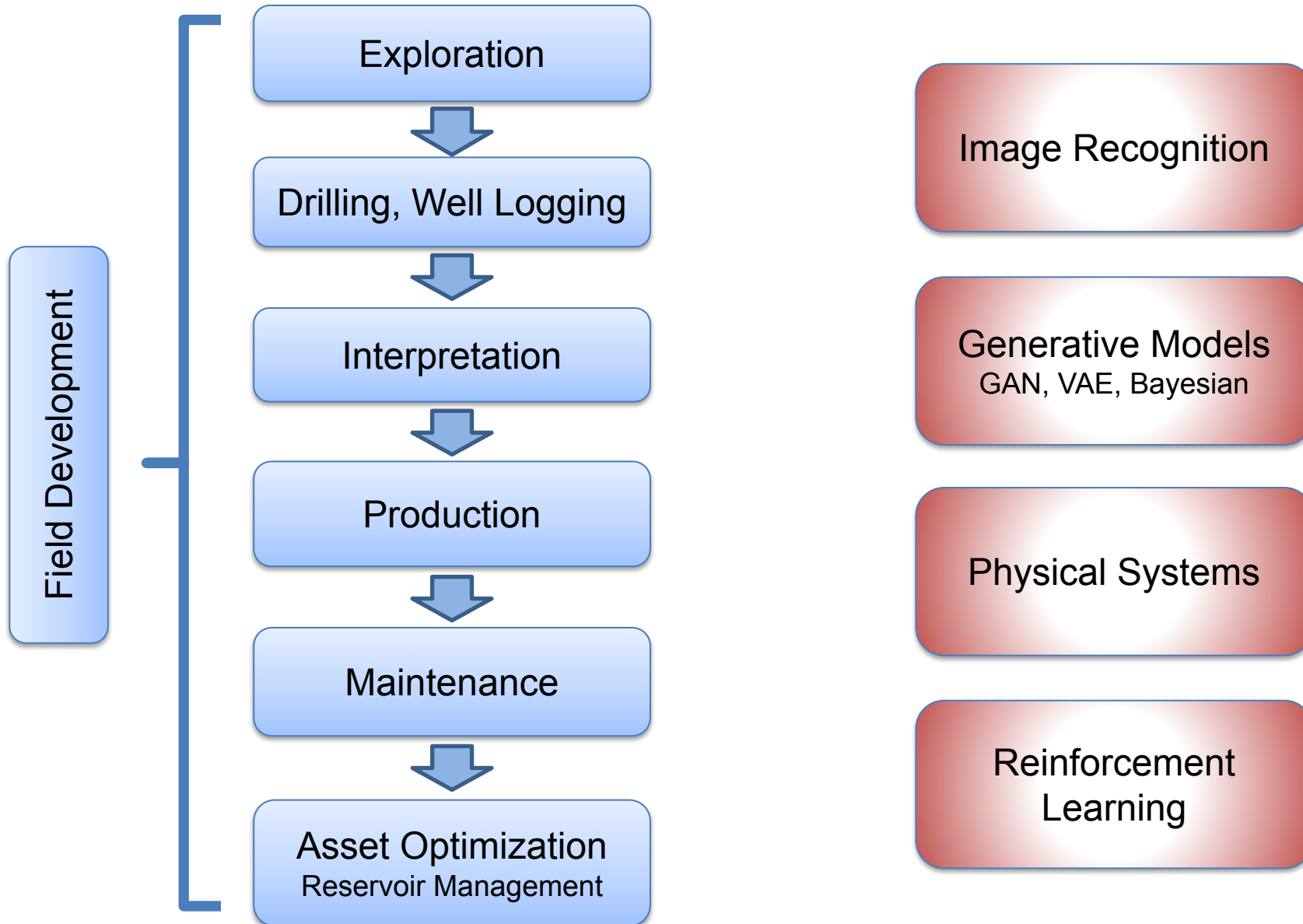
A map of world oil reserves, 2013.



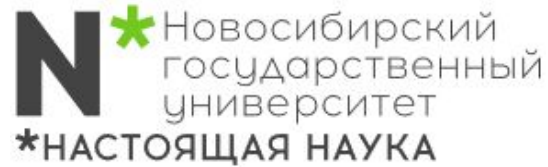
Crude Cost of Production



Machine Learning in Oil & Gas



Partnership



Laboratory on Machine Learning in Oil & Gas Industry

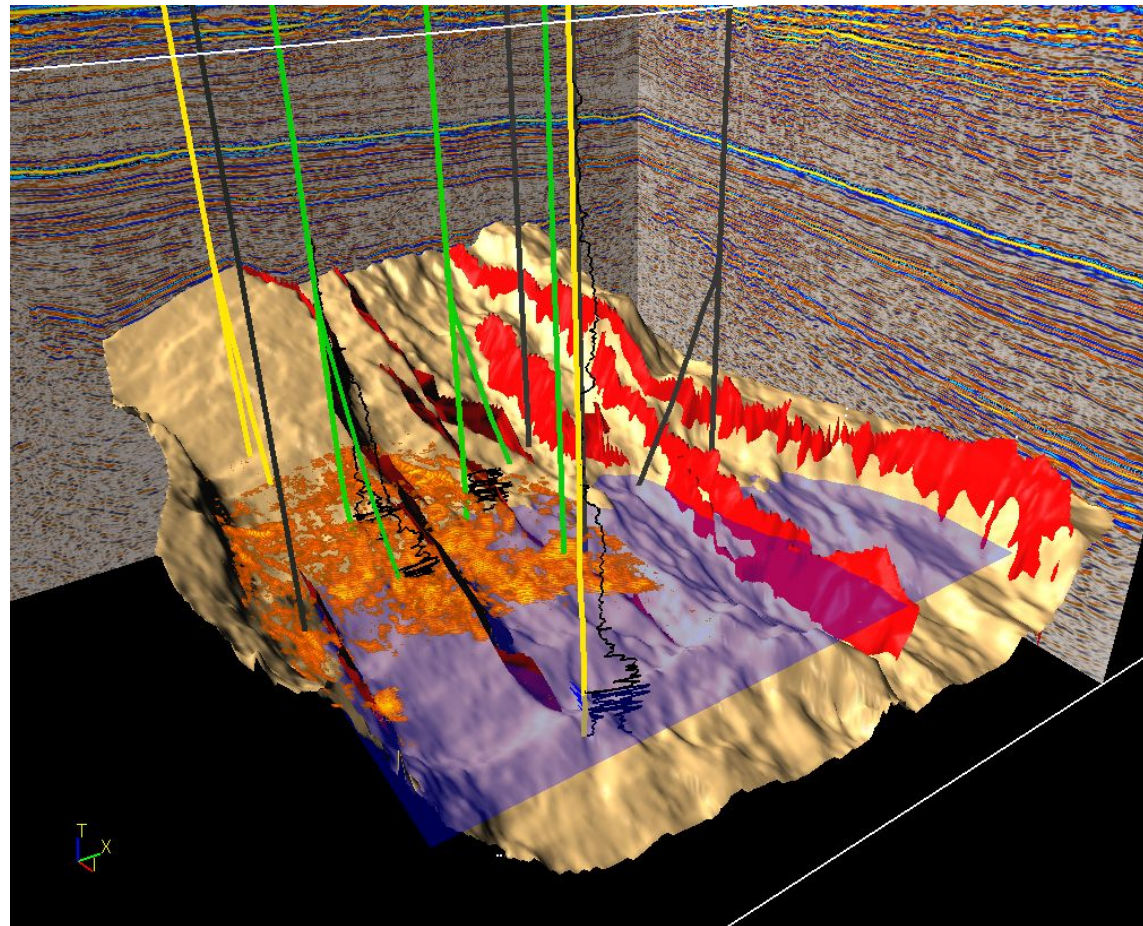
Research and Innovation Projects:

- applied projects
- partnership with oil/gas companies

Student Training:

- student thesis projects
- publications
- student professional activities

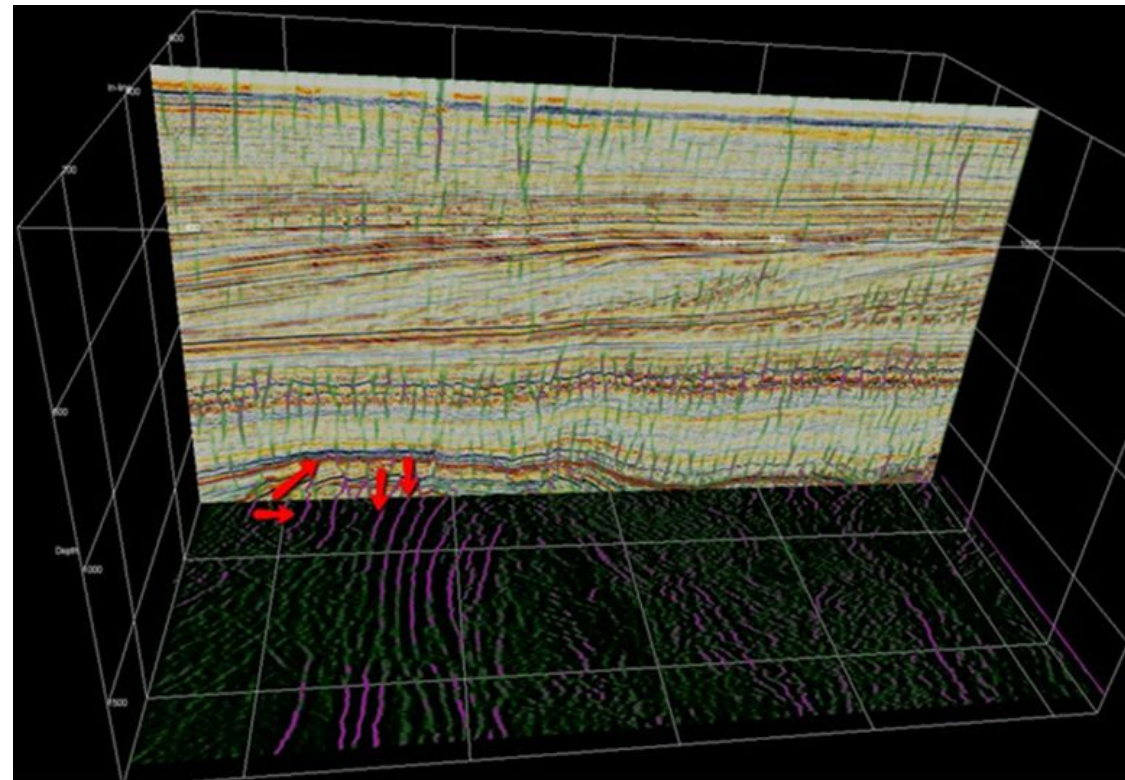
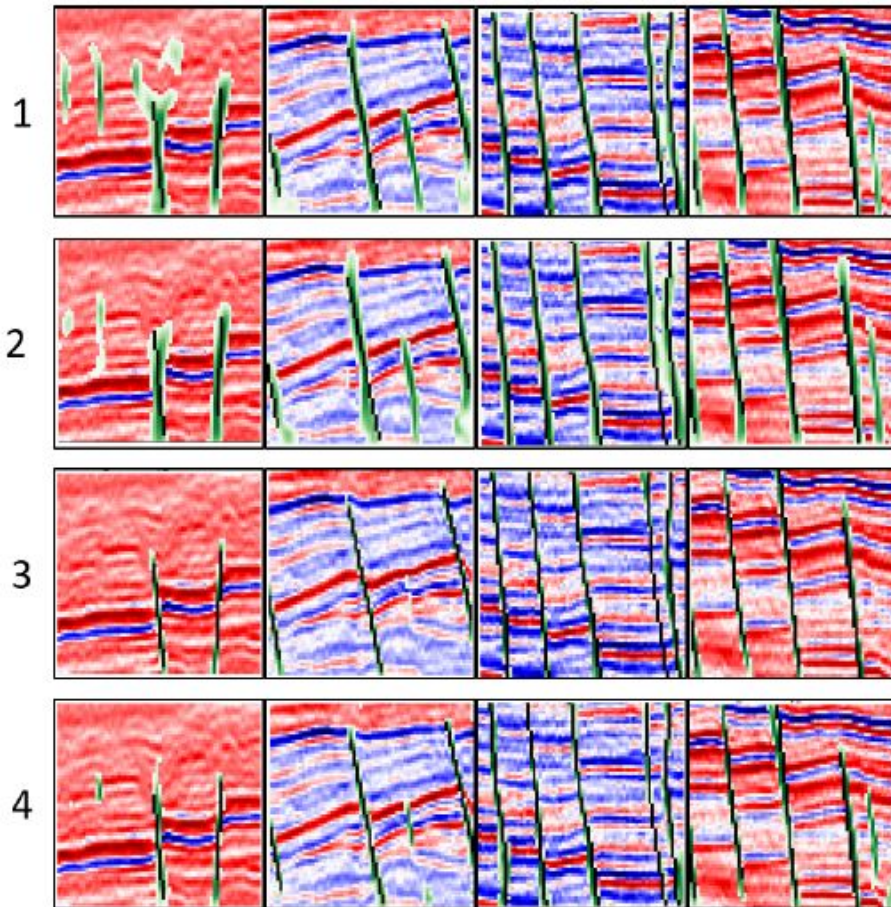
Interpretation



Fault Detection 0

Image Recognition
(CNN)

Generative Models
GAN, VAE, Bayesian

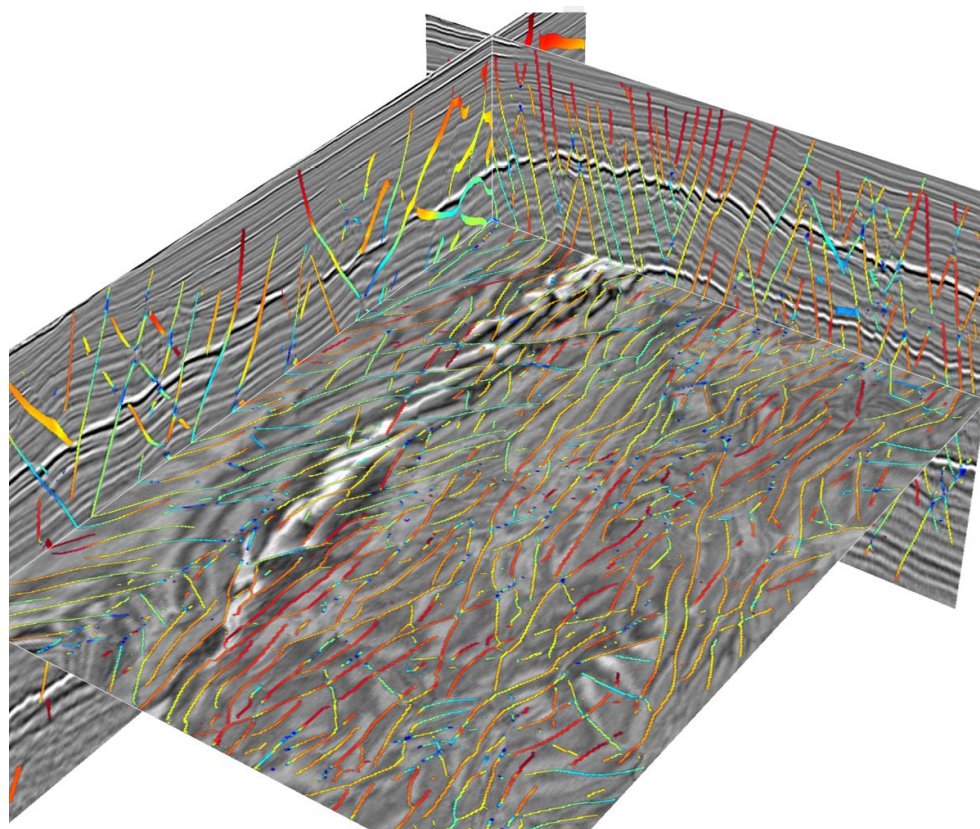


Fault Detection 1

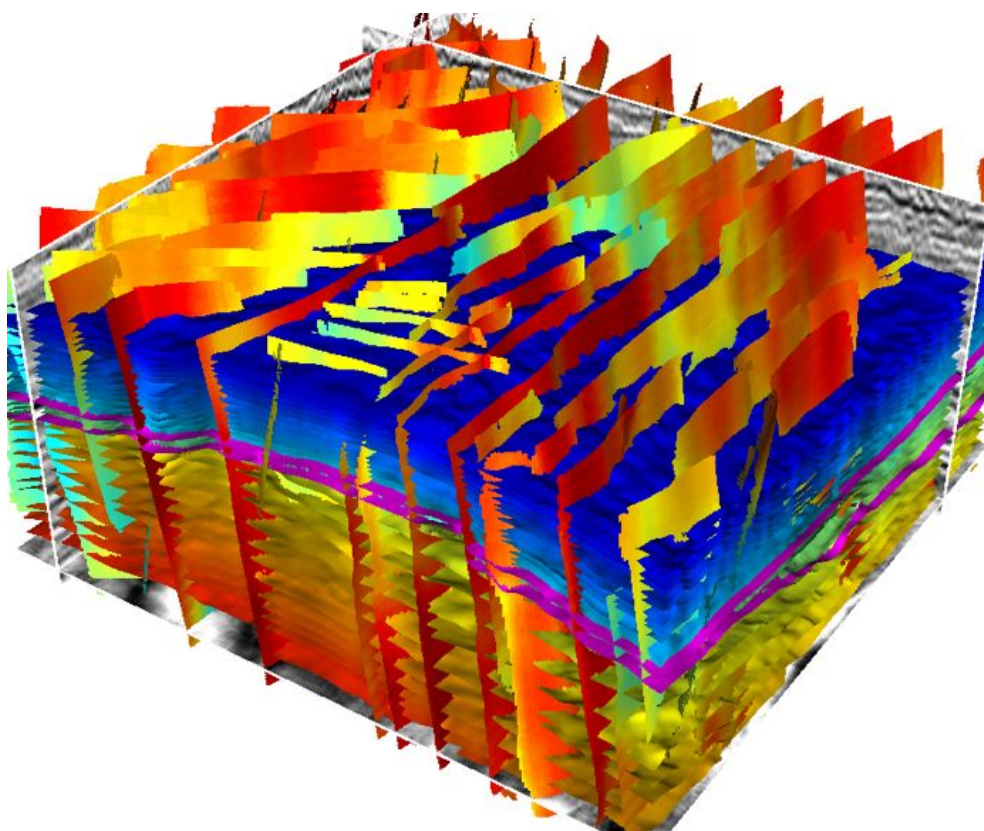
Image Recognition
(CNN)

Generative Models
GAN, VAE, Bayesian

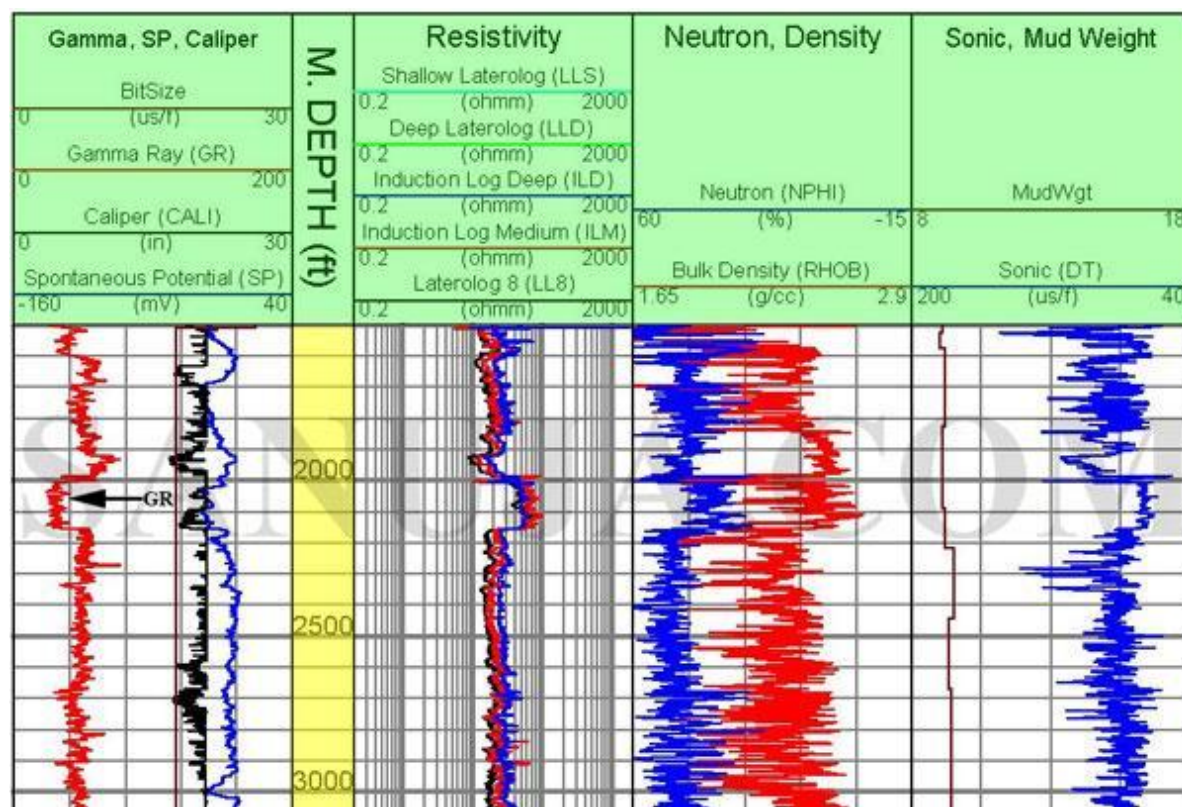
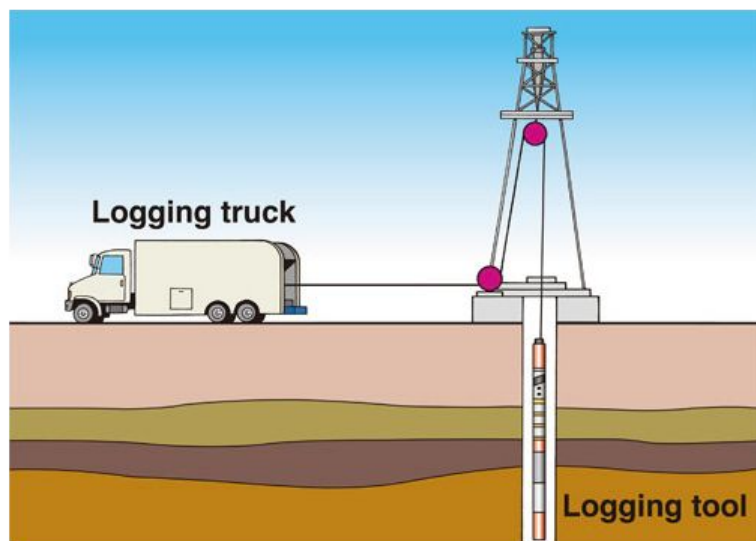
Fault detection in slices



Fault surface construction



Well logging

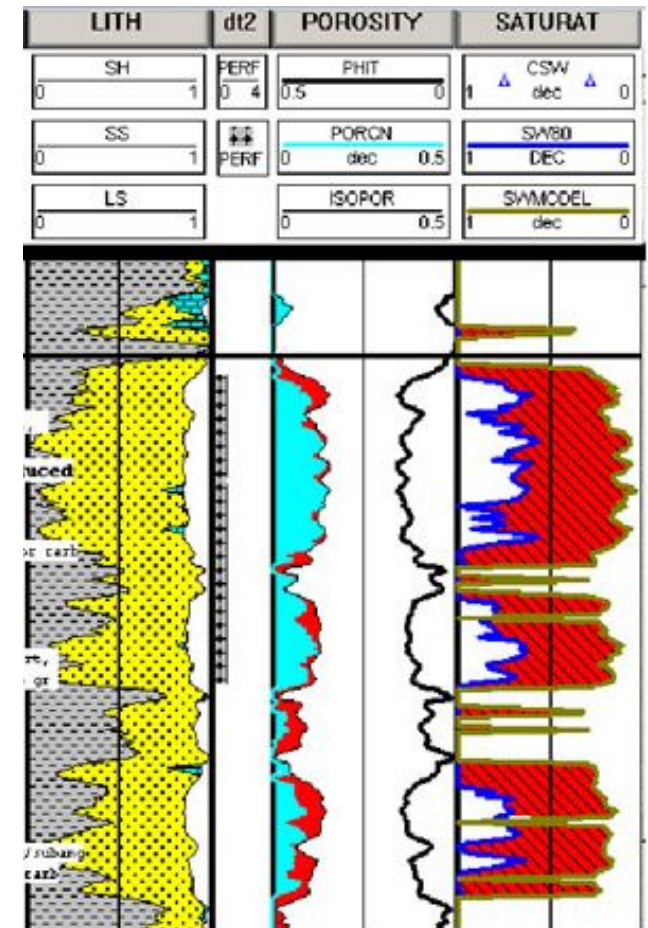
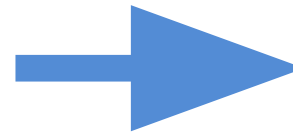
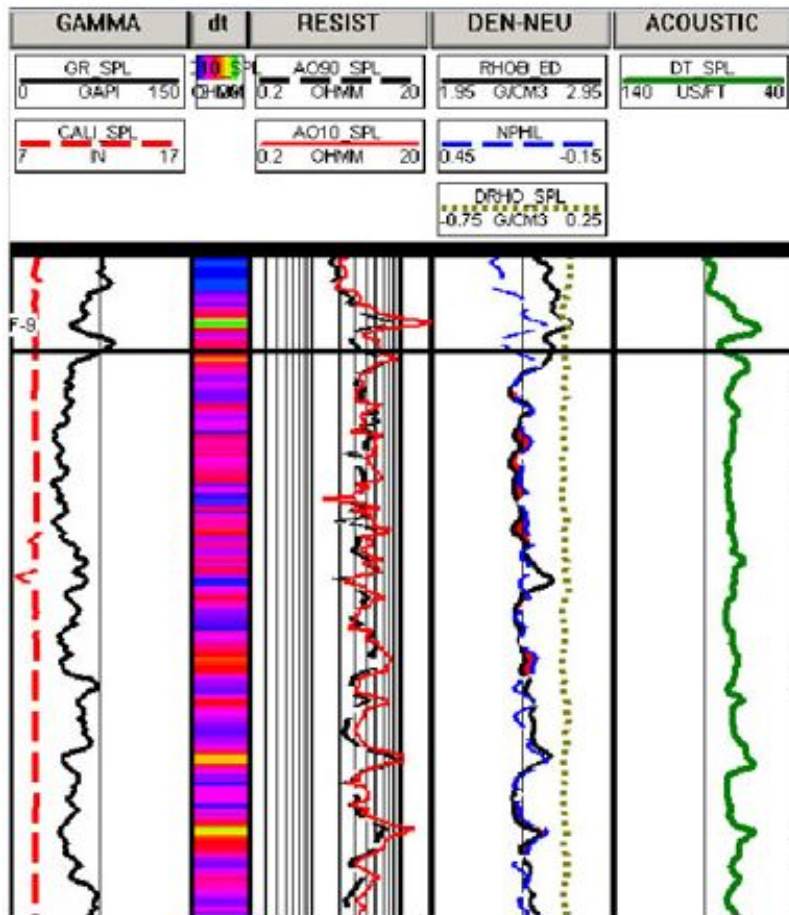


Petrophysical model

Image Recognition
(CNN)

Generative Models
GAN, VAE, Bayesian

Convert well logs to petrophysical models

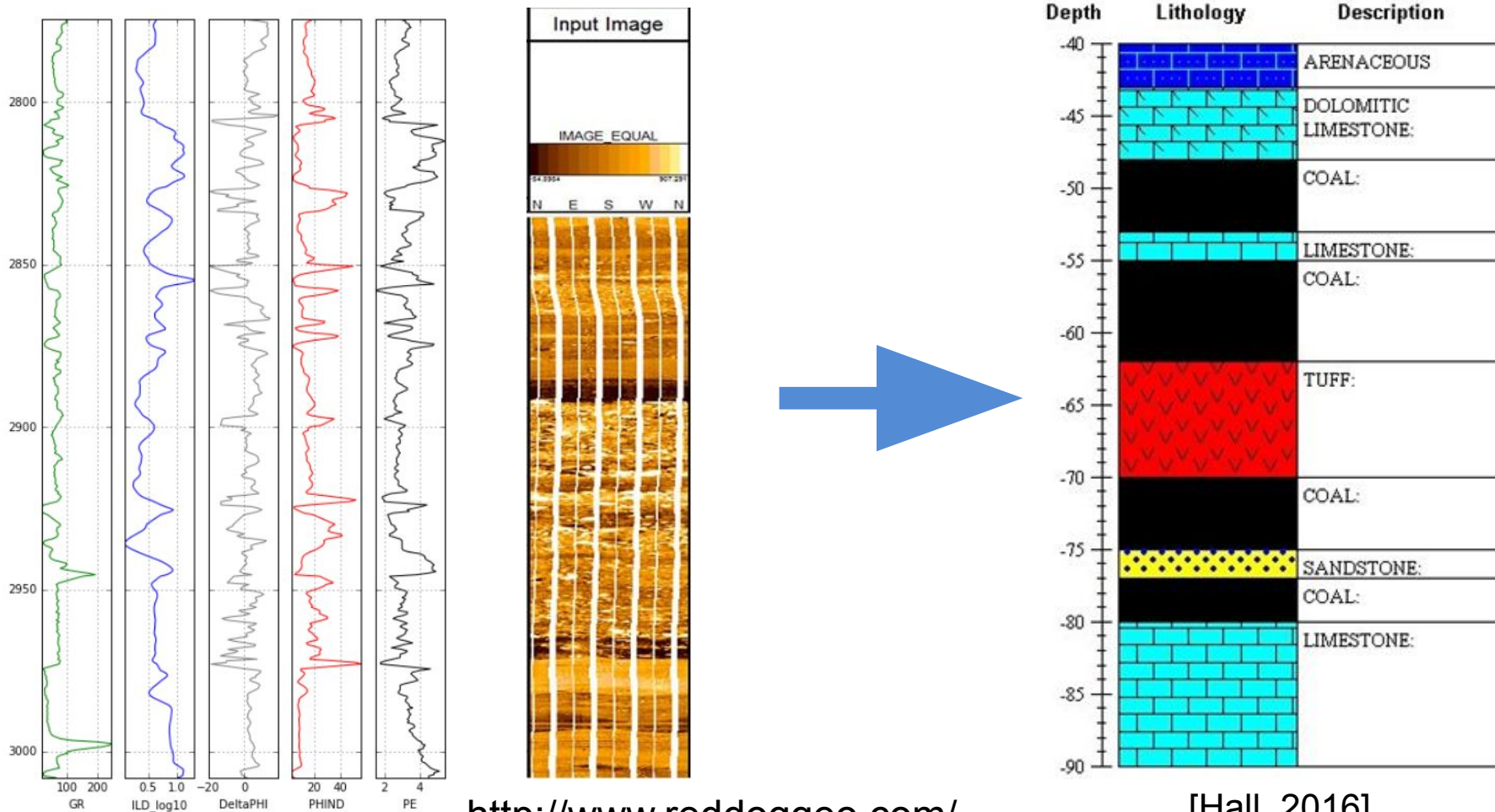


Lithological model

Image Recognition
(CNN)

Generative Models
GAN, VAE, Bayesian

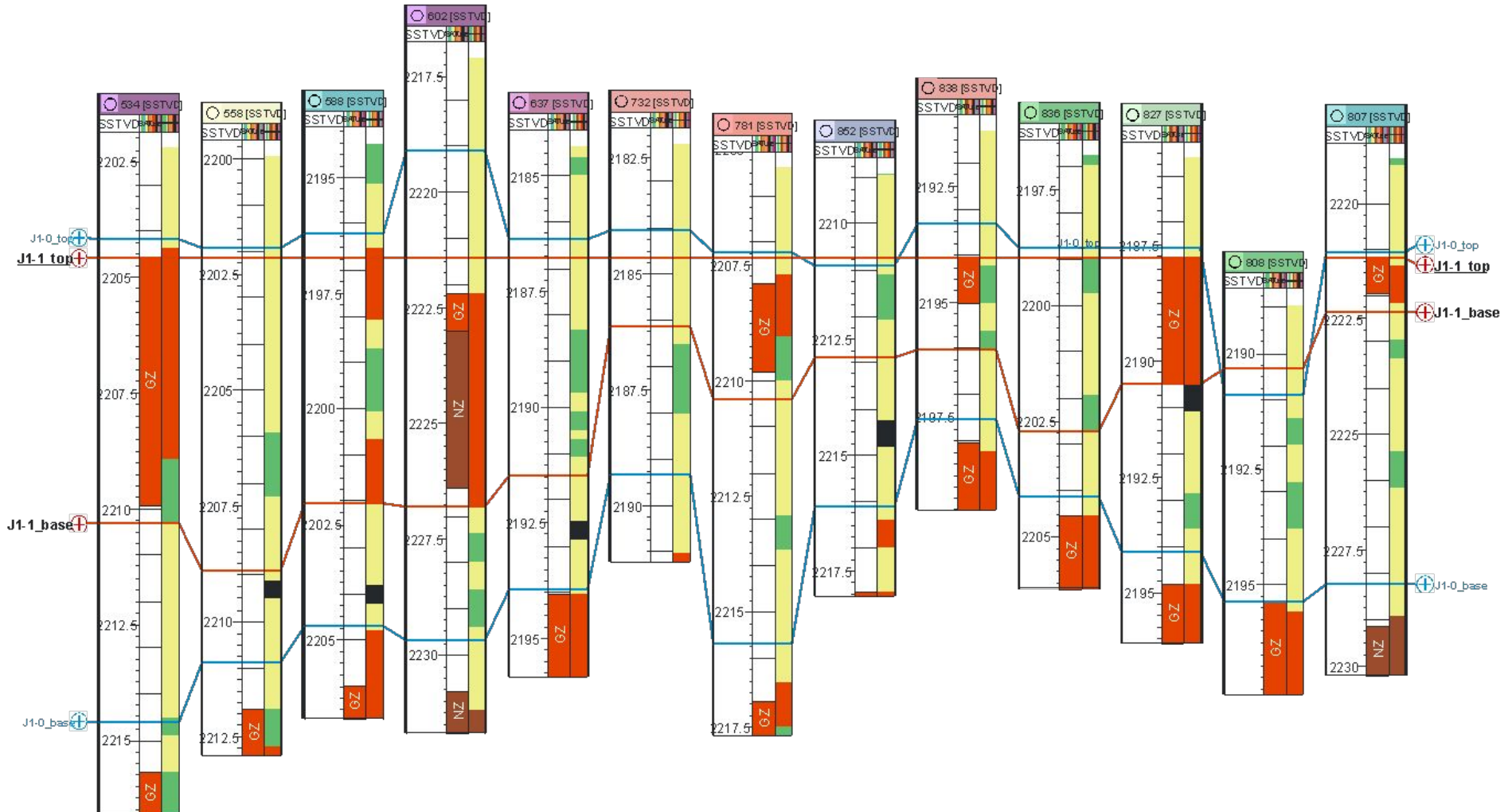
Convert well logs to rock types



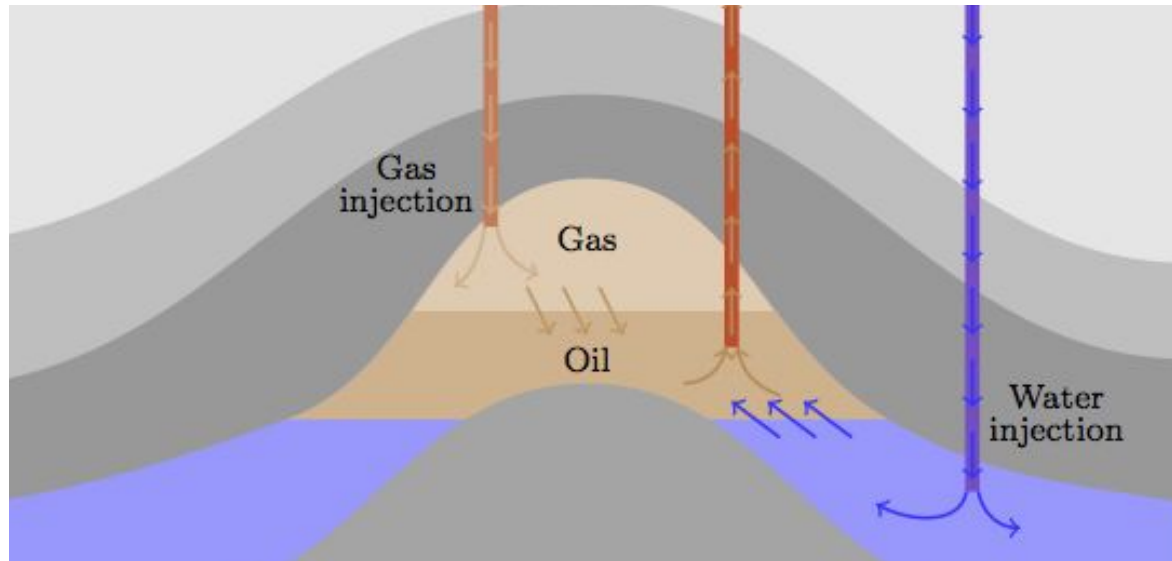
Well Correlation

Image Recognition
(CNN)

Generative Models
GAN, VAE, Bayesian



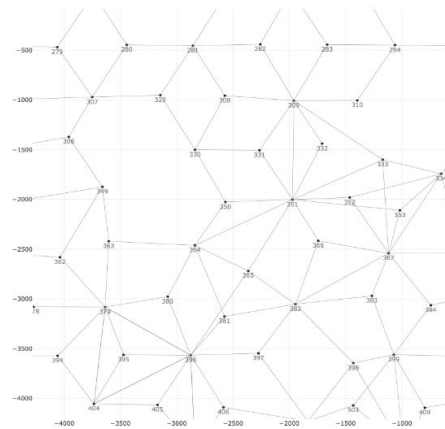
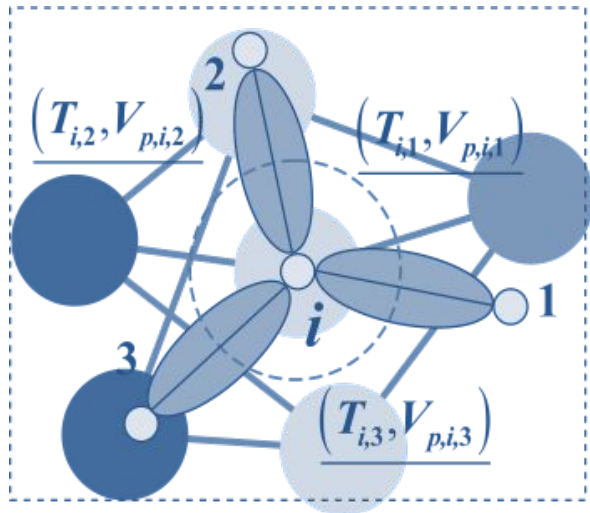
Production



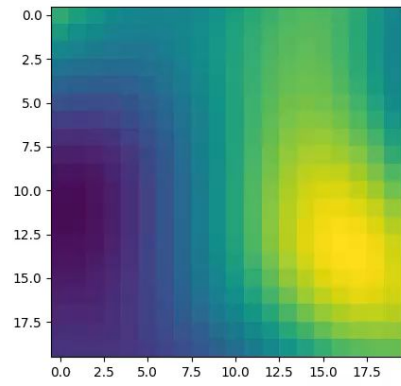
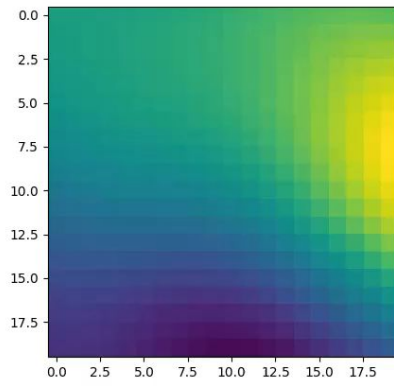
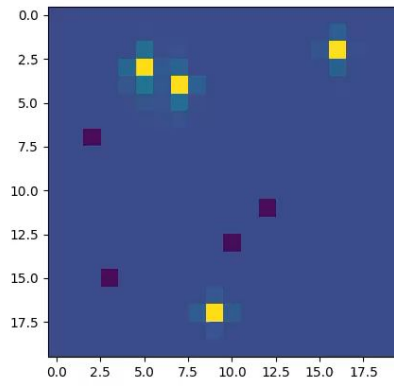
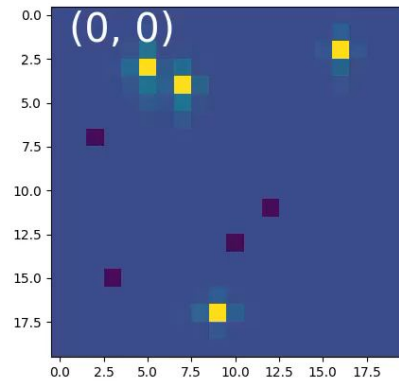
Production 0

Physical Systems
(explicit PDE)

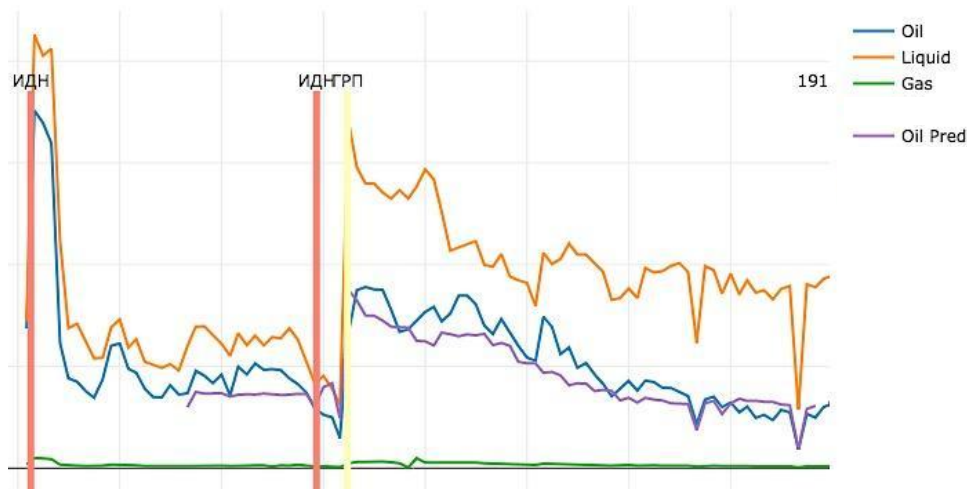
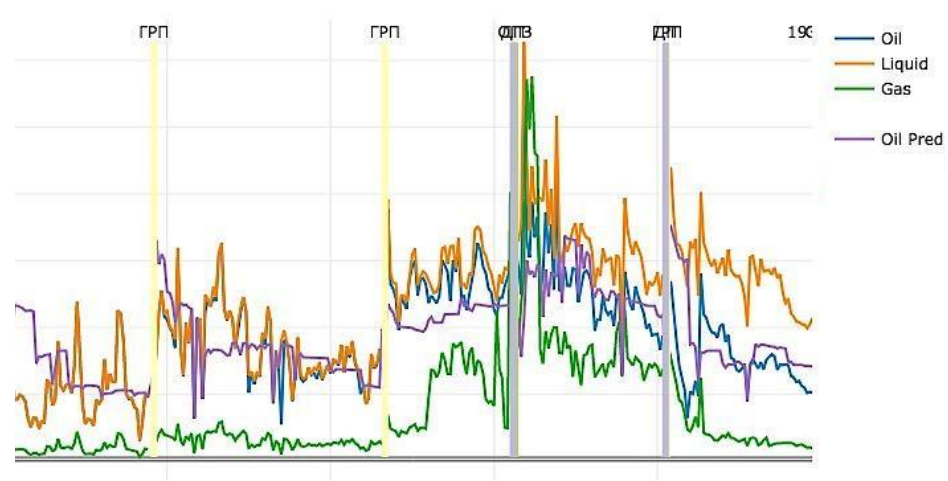
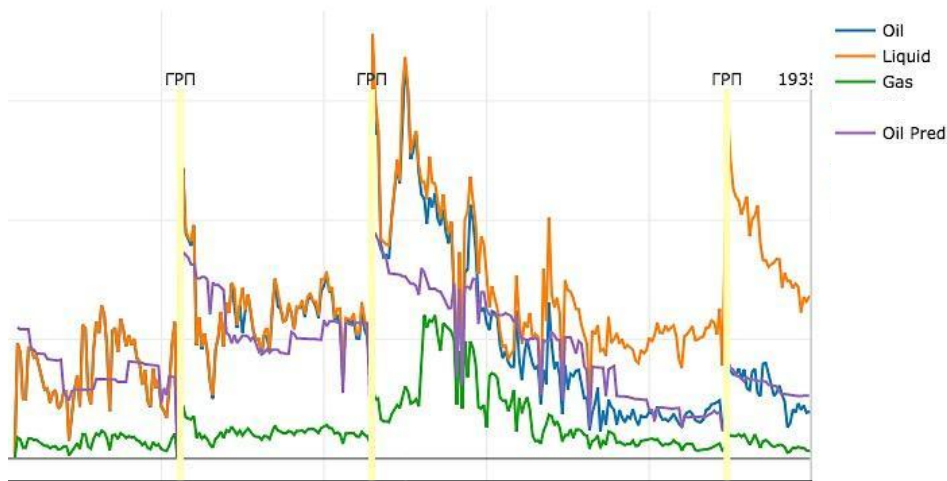
Production Modelling using Proxy Models. History matching of physical Proxy Models to production data.



Simple equations:
$$cV_i \frac{dp_i}{dt} = \sum_j T_{ij}(p_j - p_i) + q_i$$



Examples. Monthly well production.

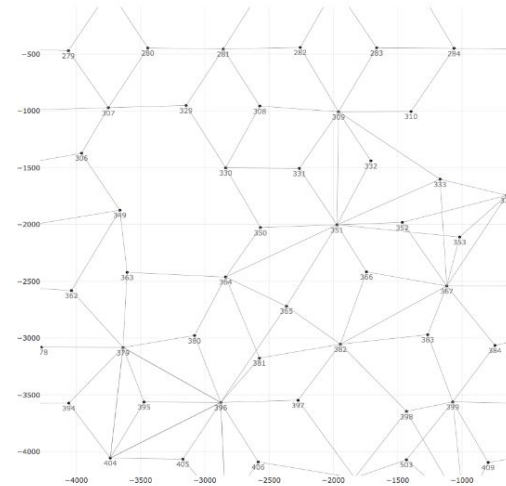
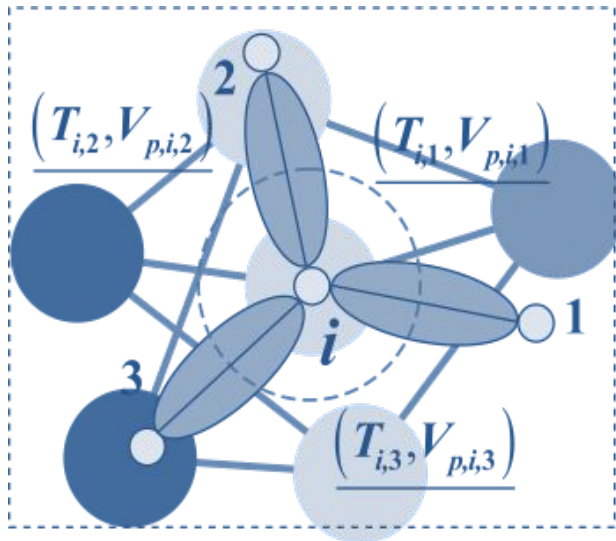


Production 1

Generative Models
(GAN, VAE, Bayesian)

Physical Systems
(explicit PDE)

Production Modelling using Proxy Models. History matching of physical Proxy Models to production data with uncertainty.



Simple equations:

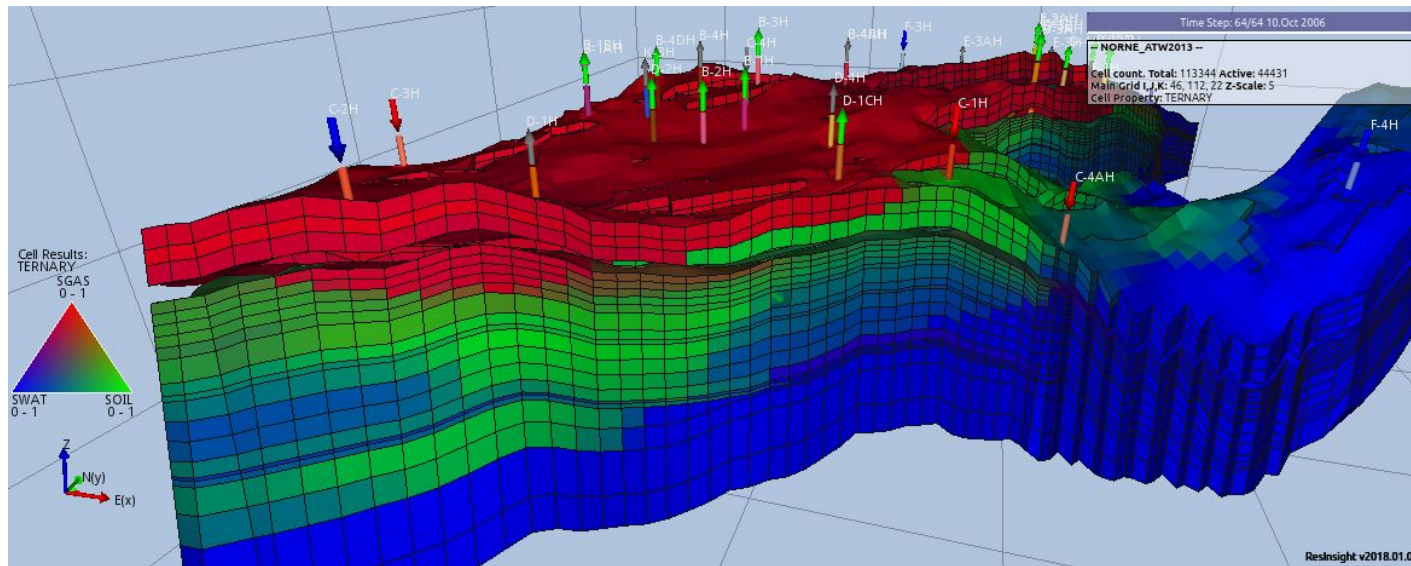
$$cV_i \frac{dp_i}{dt} = \sum_j T_{ij}(p_j - p_i) + q_i$$

Production 2

Generative Models
(GAN, VAE, Bayesian)

Physical Systems
(learn from simulator)

Production Modelling using simulator. History matching of simulator models to production data with uncertainty.



Pressure equation:
$$c\phi\rho \frac{\partial p}{\partial t} = \nabla \frac{\rho K}{\mu} \nabla p + \rho q$$

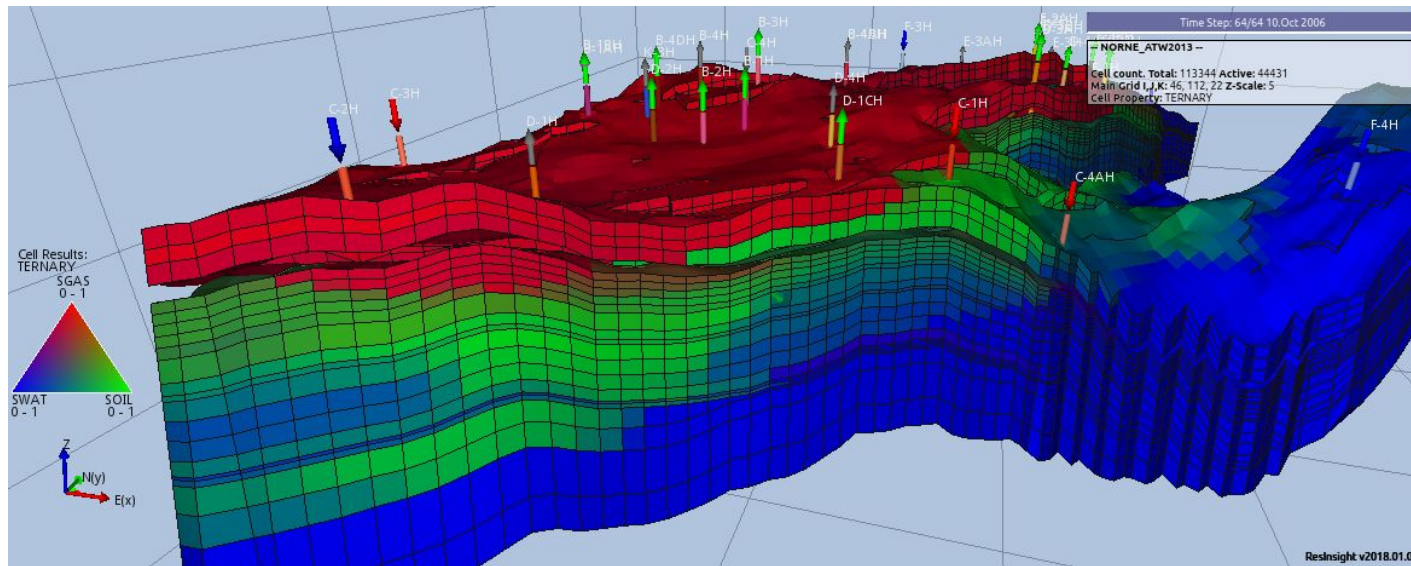
Production 3

Generative Models
(GAN, VAE, Bayesian)

Physical Systems
(explicit PDE)

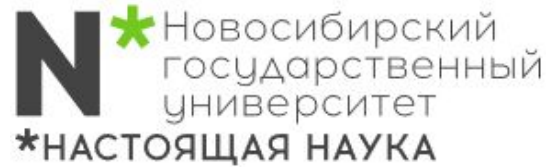
Reinforcement
Learning

Optimization of production using simulator with uncertainty.



Pressure equation:
$$c\phi\rho \frac{\partial p}{\partial t} = \nabla \cdot \frac{\rho K}{\mu} \nabla p + \rho q$$

Partnership



Laboratory on Machine Learning in Oil & Gas Industry

Research and Innovation Projects:

- applied projects
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Student Training:

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- publications
- student professional activities

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