REACHING NEW FRONTIERS IN SEISMIC INTERPRETATION

UTILIZING DEEP LEARNING COMPUTER VISION TECHNOLOGY

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TRAINING OF YOUR GEOSCIENTIST, BUT WHAT ABOUT TRAINING YOUR DATA?

The current excitement about Artificial Intelligence (AI) stems, in great part, from groundbreaking advances involving what are known as Convolutional Neural Networks (CNN).

This machine learning technique promises dramatic improvements in things like computer vision, speech recognition, and natural language processing.

You probably have heard of it by its more layperson-friendly name: **"Deep Learning."**

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TRAINING OF YOUR GEOSCIENTIST, BUT WHAT ABOUT TRAINING YOUR DATA?

You have Terabytes upon Terabytes of various seismic data, either in its raw, amplitude or derivative formats. Most of the time it lies there idle, and waiting for the geoscientist to log in and take it into use.

Why not let the data work when it is not used by the geoscientist, and outside working hours for the poor geoscientist being home an getting a well deserved sleep?
The data can in the meantime do its exercise and training and get ready for the geoscientist logging in and begin his/her work with a more intelligent data set than last time.

A dataset which now can tell the geoscientist much more, and reveal much more, making it possible to make the next discovery of hydrocarbons with larger chance of success at a much lower cost and less time efforts.

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SEISMIC FACIES IDENTIFICATION WITH USE OF IMAGE RECOGNITION PLATFORMS

The rapid rise of computer vision technology and the increasing number of companies developing image recognition platforms are enormous.

Until recently, computer vision technology has been used primarily for detecting and recognizing faces in photos. While facial recognition remains a popular use of this technology, there has been a rapid rise in the use of computer vision for automatic photo tagging and classification.

This increase is largely due to recent advances in artificial intelligence (AI), specifically the use of convolutional neural networks (CNNs) to improve computer vision methods.

So far, this technology has not won any major terrain within the Oil and Gas Industry.

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SEISMIC FACIES IDENTIFICATION
A HIGHLY SUBJECTIVE AND TIME CONSUMING TASK

Stratigraphic interpretation of seismic data is a time consuming and highly subjective methodology where the result is highly dependent upon the operators skills, training and mostly experience to recognize depositional environments and their associated geometrical attitude and occurrence.

Combine this with varying quality of the data foundation, seismic data quality and type, there are many ways this could go wrong.

The task at hand is to identify geometric patterns in the data, generate image captions/ descriptions

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SEISMIC FACIES IDENTIFICATION WITH USE OF CNN

Why not use computer vision algorithms to analyze digitized images of seismic data (original or attribute versions, does not matter). The algorithms could be trained to detect and understand visual similarities in seismic facies pattern and automatically classify these based on style, occurrence etc.

Utilize Convolutional Neural Networks (CNN) that are able to learn complex visual concepts using massive amounts of data,, could save time and efforts, but not only that; create a more objective analysis of the data.

The use of machine learning and image processing algorithms to analyze, recognize and understand visual content could prove to be a ground breaking way to analyze large amount of data, both in Supervised Neural Networks (SNN), but also as Unsupervised Neural Networks (UNN), like the CNN.

The computer gets trained to find patterns within the data with the use of deep learning-based computer vision technology to analyze, recognize and understand the content of an image.

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SEISMIC FACIES IDENTIFICATION WITH USE OF COMPUTER VISION TECHNOLOGY

The concept of CNN has been around since the 1940s, it is only within the last few years that the use of CNNs has really taken off.

CNNs are being used to significantly improve computer vision, speech recognition, natural language processing and other related technologies.

Companies are doing amazing research in the field of artificial intelligence, and democratizing breakthroughs in AI.

With so many advances in deep learning-based computer vision technology happening just within the last few years, it will be exciting to see how we can use this field of computer vision in the not-too-distant future within Seismic Stratigraphy applications.

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SEISMIC STRATIGRAPHY WHAT AND HOW

Seismic Stratigraphy is basically a geologic approach to the stratigraphic interpretation of seismic data.

Seismic reflections allow the direct application of geologic concepts based on physical stratigraphy.

Primary seismic reflections are generated by physical surface in the rocks, consisting mainly of strata surface and unconformities with velocity-density contrasts.

Therefore, possible to identify primary seismic reflections parallel strata surface and unconformities.

A seismic section is a record of chronostratigraphic (time-stratigraphic) depositional and structural patterns and not a record of the time-transgressive lithostratigraphy (rock-stratigraphy)

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SEISMIC STRATIGRAPHIC INTERPRETATION IS A MAJOR PATTERN RECOGNITION EFFORT

It is possible to make the following types of stratigraphic interpretation from the geometry of seismic reflections correlation patterns:

- geologic time correlations
- definition of genetic depositional units
- thickness and depositional environment of genetic units
- paleo bathymetry
- burial history
- relief and topography on unconformities
- paleogeography and geologic history

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SEISMIC STRATIGRAPHIC INTERPRETATION PROCEDURE

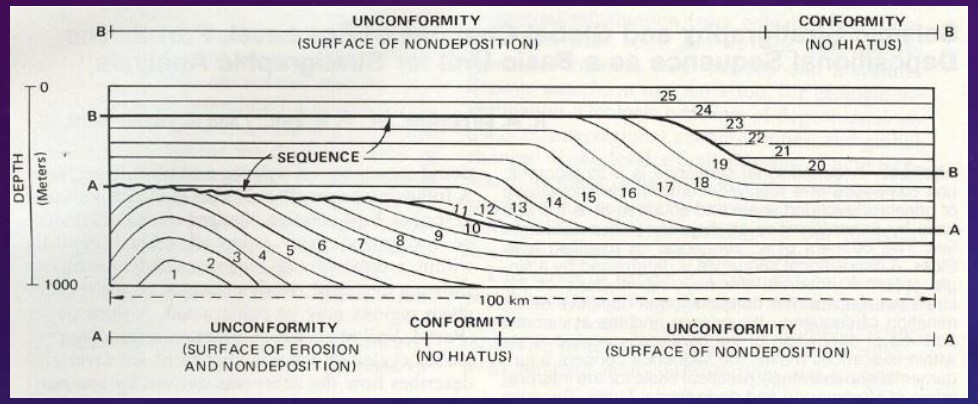
To accomplish these geologic objectives you follow three step interpretational procedure:

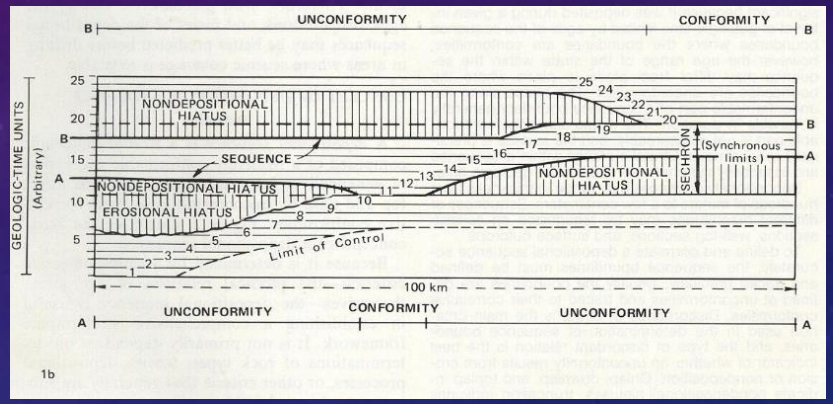
- seismic sequence analysis
- seismic facies analysis
- analysis of relative changes of sea-level

Seismic sequence analysis is based on the identification of stratigraphic units composed of a relatively conformable succession of genetically related strata termed depositional sequence

The upper and lower boundaries of depositional sequences are unconformities or their correlative conformities.

CONVOLUTIONAL NEURAL NETWORKS (CNN) TO IMPROVE IDENTIFYING DEPOSITIONAL SEQUENCES



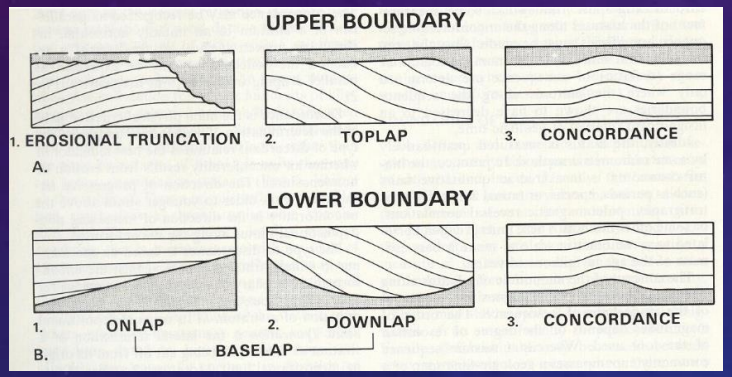


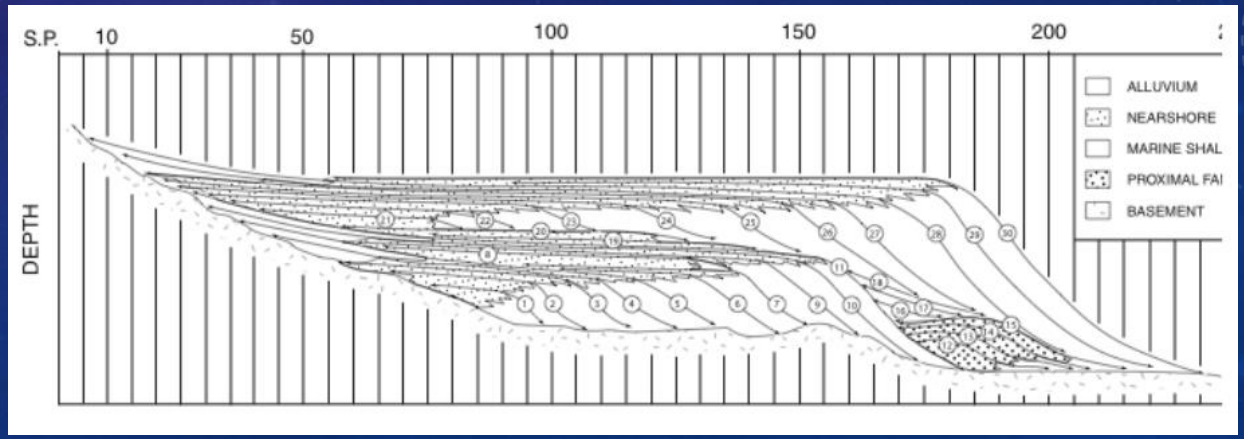
Depositional sequence boundaries are recognized on seismic data by identifying reflections caused by lateral terminations of strata

TRAINING THE LEARNING COMPUTER THROUGH ARTIFICIAL INTELLIGENCE

Depositional sequence boundaries are recognized on seismic data by identifying reflections caused by lateral terminations of strata termed:

- onlap
- downlap
- toplap
- truncation





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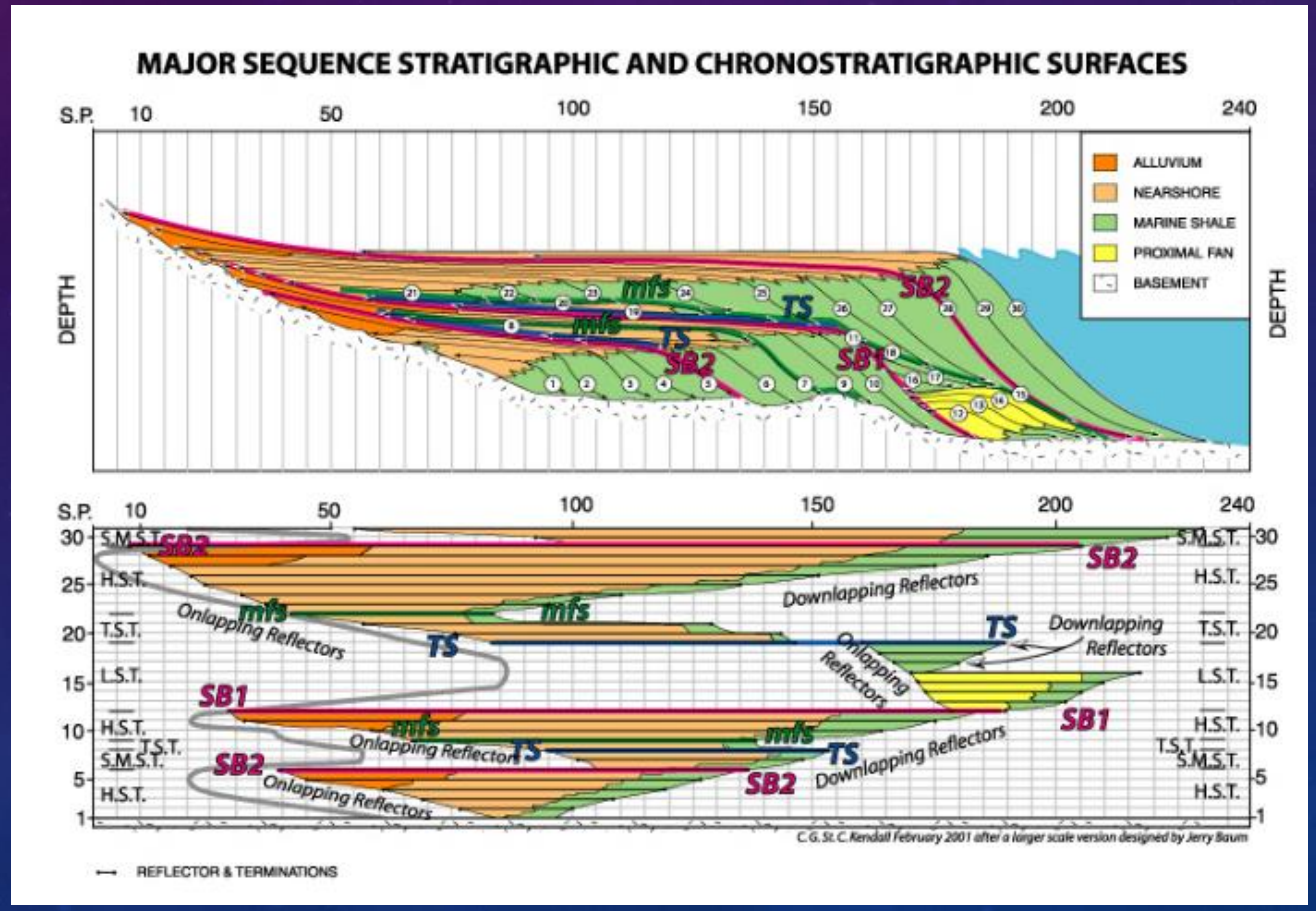
USE OF VISION TECHNOLOGY TO PERFORM CLASSIFICATION OF SEISMIC STRATIGRAPHIC GEOMETRIES



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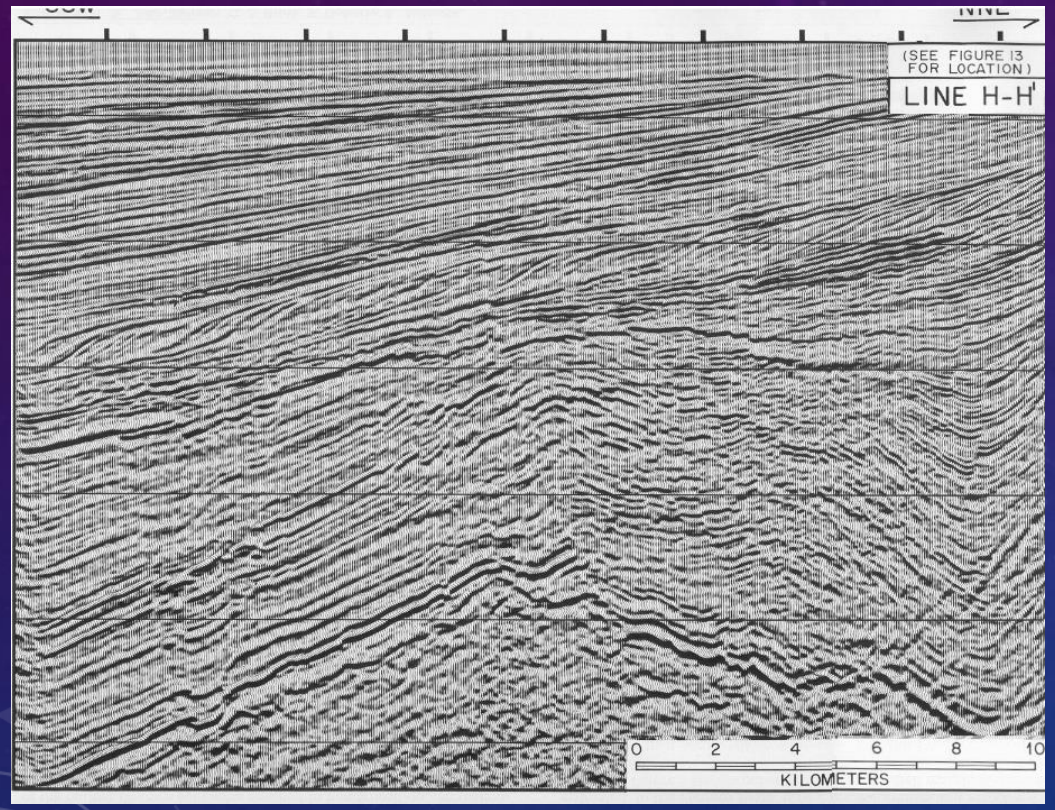
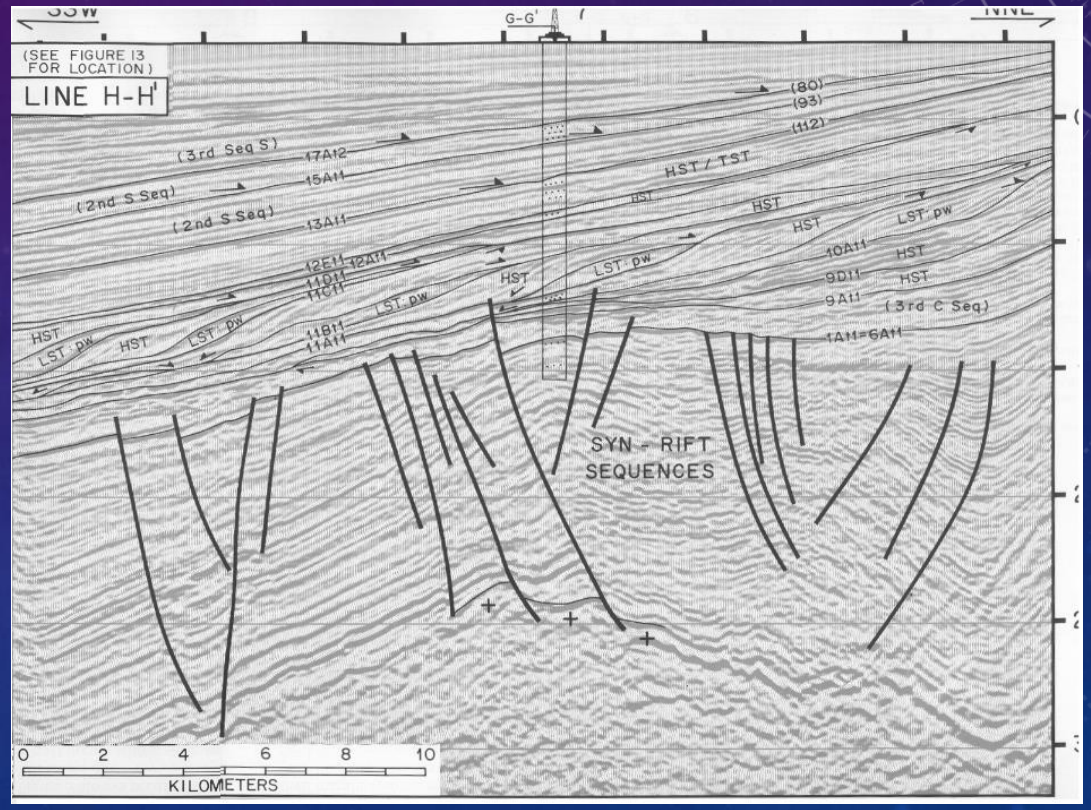
AUTOMATIC IDENTIFICATION OF SEISMIC STRATIGRAPHIC PATTERNS





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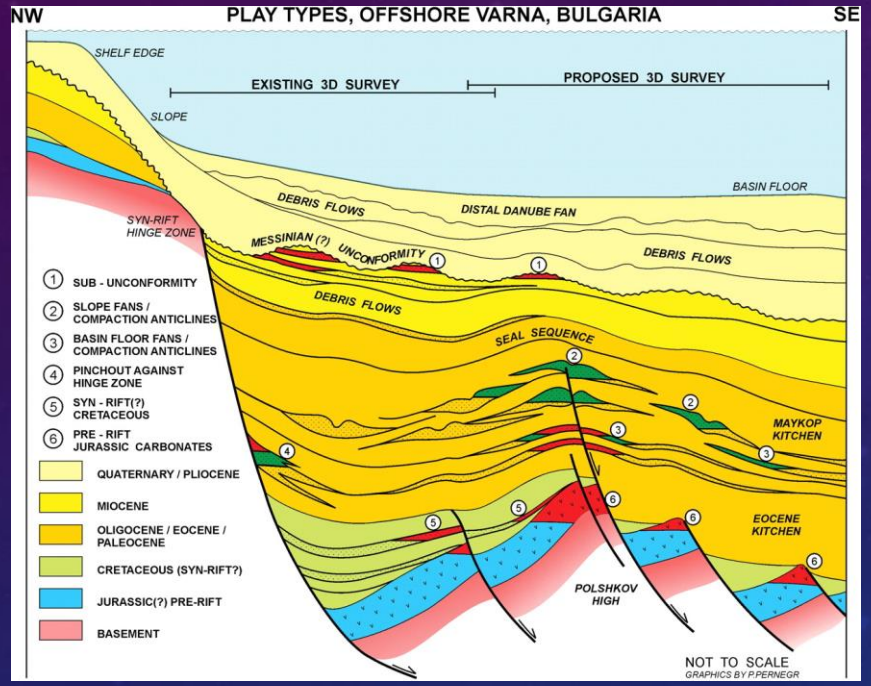
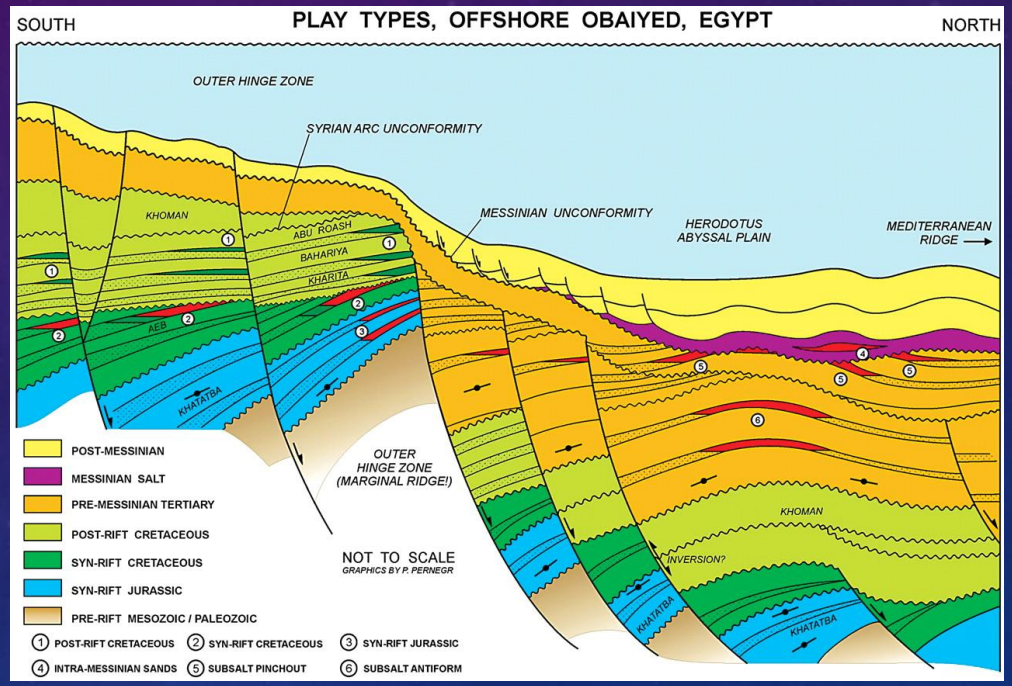
LEADING TO AUTOMATIC IDENTIFICATION OF PLAY TYPES





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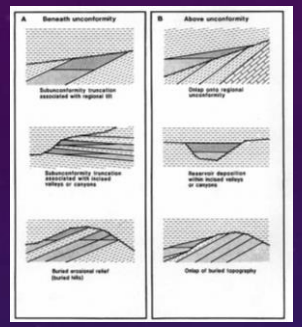
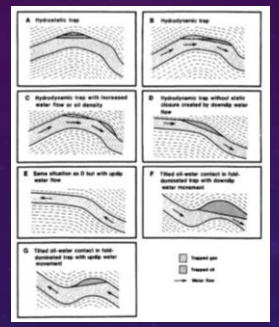
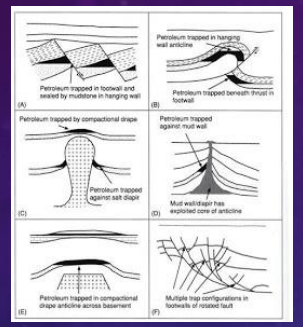
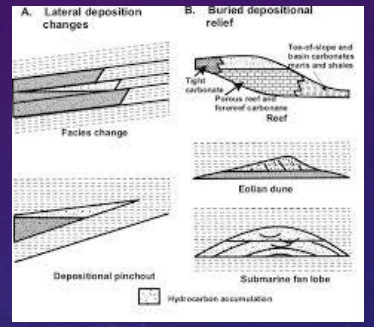
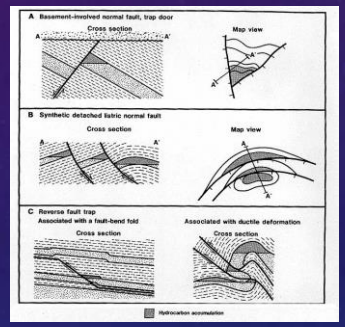
AUTOMATIC IDENTIFICATION OF PLAY TYPES, LEADS AND PROSPECTS

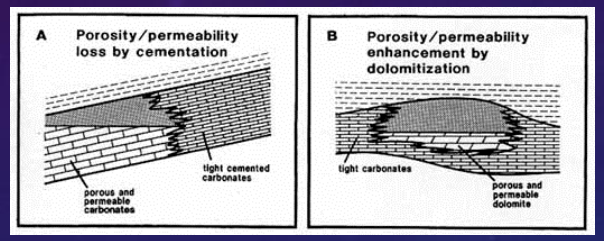


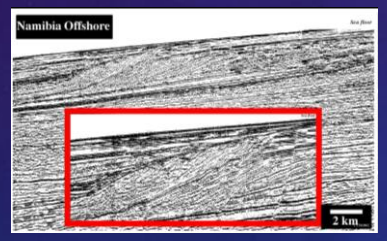


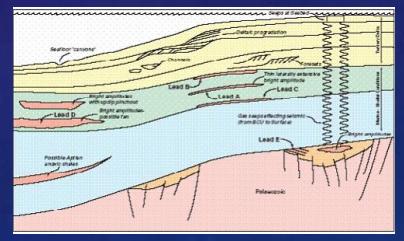












Train your data towards well-known play types, trap types in the region and part of the stratigraphy. In addition have a library of known types from other areas, you never know, you might find it in your data too.

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TAG YOUR PLAY TYPES, LEADS AND PROSPECTS LIKE YOU DO IN FACEBOOK OR IPHOTO APPLICATIONS