SUCO Confirms New Gas Prospect Based on Seismic Attributes Using the Petrel Platform, Egypt

Neural network technique differentiates gas-bearing sand reservoirs across North Sidi Ghazy field

CHALLENGE
Delineate gas prospects in a small area by using a far-angle seismic dataset and then efficiently extrapolate the analysis across the entire area of interest.

SOLUTION
- Collaborate with Schlumberger to use the Petrel® E&P software platform to generate seismic attributes that assist in lithology classification and fluid evaluation.
- Build a seismic classification cube for the three classes of gas-bearing sand, water-bearing sand, and shale by using the seismic attributes in a neural network technique within the Petrel platform.

RESULTS
Identified new prospective areas — confirmed by drilling — from the neural network technique’s assessment of the seismic attributes of gas-bearing sand reservoirs.

Delineating direct hydrocarbon indicators by using seismic attributes
Suez Oil Company (SUCO) is an Egyptian consortium joint venture with concession rights to the North Sidi Ghazy gas field on the onshore part of the Nile Delta. Well A was drilled and penetrated a 174-m section of the Upper Messinian Abu Madi Formation. The sediments had been deposited in a semiarid lower deltaic plain environment. The reservoir facies comprises distributary channels and crevasse sands, with interbedded floodplain shales and siltstones.

“The Petrel platform makes the process of sharing data between asset team members (geophysicists, geologists, and reservoir engineers) fast and easy to allow building a reality of 3D reservoir characterization models with the results stored within the Petrel platform project. We are looking forward to more innovative techniques with such impressive results.”

Taha Adly Abd El-Rahman
Section Head of Geology Sector
Suez Oil Company

SUCO has multiple realizations of both time- and depth-processed seismic data that focus on specific levels, including pre-stack time migration (preSTM) volumes for the entire area that target the Pliocene and Messinian sands and preSTM gathers for angle stack volume generation and AVO analysis. SUCO wanted to use the latter to efficiently delineate gas projects with a high degree of confidence across the field. The far-angle stack volume was used to derive seismic volume attributes to reveal subtle structural and stratigraphic geological information that would not have been evident otherwise.
CASE STUDY: Neural network technique with the Petrel platform identifies gas sands for SUCO, Egypt

Original seismic signature and gamma ray responses from three wells in an interpretation window.

3D view of the inverted seismic volume with identification of gas-bearing sands (light blue), water-bearing sands (dark blue), and shale (pink).

In recognition that the volume attributes would improve geological and geophysical interpretation, SUCO defined four independent volume attributes to assist hydrocarbon evaluation:

- **sweetness** — the implementation of two combined attributes used for the identification of features where the overall energy signatures change in the seismic data
- **rms amplitude** — root-mean-squares computed on instantaneous trace samples over a specified window with the window length parameter defined by the number of samples
- **reflection intensity** — the average amplitude over a specified window multiplied with the sample interval, which is useful for the delineation of amplitude features while retaining the frequency appearance of the original seismic data
- **envelope amplitude** — detection of bright spots caused by gas accumulations or lithological changes and sequence boundaries that generate strong energy reflections for clearly showing subtle lithological changes that may not be apparent in the original seismic data.

**Training the neural network for seismic classification**

SUCO collaborated with Schlumberger to identify and generate the critical volume attributes and use them as input for seismic classification. An unsupervised neural network technique was employed to efficiently identify gas prospects across the field with a minimum of effort.

The objective was to delineate three classes from the training dataset: gas-bearing sand, water-bearing sand, and shale. These results would be used to guide identification of the hydrocarbon distribution across the reservoir interval. Correlation analysis was performed first to assess the spatial relationship between the seismic attributes. A strong correlation was confirmed for the different seismic volume attributes.

An inverted seismic cube was created from the model, representing the three classes. This result was then resampled into a static model used to condition property distributions.

**Efficiently and reliably identifying gas sands**

The new model created using advanced geophysical techniques within the Petrel E&P software platform brought significant efficiencies to delineating the hydrocarbon distribution across the entire field. The results considerably improved on the conventional seismic interpretation approaches previously used in both speed and accuracy.

As a result of this study, a new well was successfully drilled, and the logging data confirmed that it accessed hydrocarbons in the target interval.

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