



The use of 3D seismic analysis techniques for investigating carbonate features in the UAE

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Introduction

Carbonate reservoirs in the Persian Gulf are complex integrated systems which are often hard to interpret. The identification of subtle fracturing as well as karst features and build-ups is further complicated by poor data quality. We present the results of applying 3D seismic analysis techniques to create attribute and object volumes which provide insight into the structure and faulting of the reservoir sections of two producing fields offshore UAE.

This investigation focuses on the massive aggrading Thamama complex of the Lower Cretaceous and the Middle Cretaceous Mishrif reef build-up. Carbonate build-ups of the Mishrif were controlled by localised salt diapirism and associated bathymetric variations. These carbonate formations are among the most important reservoirs in the Middle East and contain a large proportion of the world's oil reserves. A good understanding of the geomorphological evolution as well as the structural and stratigraphic properties of these formations is crucial in defining reservoir properties.

The workflow applied to the data was split into 3 sections: Data Conditioning, Fault Analysis, and Stratigraphic Analysis.

Data Conditioning

The post stack time migrated data was dominated by steeply dipping coherent noise. This made interpretation difficult and post stack noise attenuation was essential to prevent artefacts being introduced into any attributes that were created on the data. The noise was attenuated using a sequence of FMH filters that are both structurally oriented and edge preserving. This workflow attenuated the noise but maintained the reflector terminations and the characteristic of the data.

Fault Analysis

In one of the areas at the Thamama horizon there are two potential fault scenarios: either a single NW-SE trend of faulting, or the NW-SE trend accompanied by a perpendicular NE-SW trend which is hard to identify in the data. The objective of the fault workflow was to identify the subtle faulting around a key well location to clarify which of the faulting scenarios was present. A combination of structurally oriented attributes identifying both discontinuities and curvature were used to highlight the faults. Two perpendicular trends were seen in the attribute data with different expressions along each trend suggesting the second scenario was more probable.

Stratigraphic Analysis

Extensive studies of the seismic response of carbonate systems have led to the development of a suite of workflows capable of highlighting subtle carbonate features. These techniques were applied to both data sets, including frequency analysis, bedform analysis, and eigen analysis. In the second area, frequency decomposition and RGB blending highlighted frequency variations within the vicinity of the key wells along a fault line that had been identified in the earlier fault analysis. It also highlighted circular features consistent with



the expected response from karstified layers. Eigen analysis was used to investigate these features further, and again the results indicate the presence of karst.

Bedform analysis was used within the Falah field to identify and extract pinch-outs and clinoforms directly below the Mishrif horizon. The Bedform workflow identifies individual layers by isolating constant phase events. These are combined with the instantaneous frequency to create an attribute in which pinchouts, onlaps and downlaps are easily identified. Extraction of these clinoforms as geobodies enabled their lateral extent and shape to be easily visualised.

Summary

Attribute analysis and object extraction has proved to be a valuable tool for detailed investigation into the carbonate features within these two fields. It has provided a level of detail that is hard to achieve with manual interpretation and has given new insights into the geology and reservoir properties. By analysing the individual component parts of the seismic data (amplitude, frequency, phase, and lateral variability) it has been possible to extract a high level of information out of the data which is directly relevant to the interpretation.