Overview of the Key Structural Tools for Seismic Interpretation and Structural Model QC

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ABSTRACT

Structural interpretation of seismic sections is essential in hydrocarbon exploration. For this study, a 3D time migrated seismic data from the North Sea is used which shows interpretation challenges similar to offshore Oman. A typical workflow for structural interpretation includes the following steps:

• Data conditioning
• Identifying of fault pattern using seismic attributes
• Manual or automatic fault extraction and fault modelling
• Seismic interpretation guided by faults
• Structural modelling as QC for structural interpretation and mapping

Removal of noise from the seismic data is a major element of data conditioning. Especially in case of complex structures it is of critical importance that the smoothing is guided by the seismic horizons thus not destroying steep slopes. The function "Cosine of Instantaneous Phase" is of great help interpreting structurally challenging regions. This attribute is not new, in fact it belongs to the family of complex attributes which was presented to the geophysical community in 1979 (Taner et al, 1979). The big advantage of this attribute is that it shows most clearly the continuity of seismic horizons because it is amplitude independent. Another ‘old’ and sometimes underestimated attribute is relative acoustic impedance. It is well suited for mapping thin layers because its wavelet main lobe lies approximately at the center of the layer. Much work has been done in developing multi-trace attributes suitable of detecting subtle faults. Reservoirs are getting more and more challenging with possible compartmentalization. A major challenge has been to provide consistent attributes. By this we mean that the attribute value derived at a trace is independent of the direction the algorithm is selecting the input traces (Astratti et al. 2014). This new class of attributes that includes the well-known dip and curvature shows immediately its superiority to the equivalent classic ‘non- consistent’ attributes. Depending on the complexity of the structure the fault pattern can be either automatically derived from the attribute cubes or else manual tracked guided by the structural attributes. The reliability of the seismic horizon interpretation highly depends on several parameters such as the S/N of the seismic, the fault pattern, migration quality, frequency content etc. Seismic attributes like RMS amplitude and Variance can be extracted along the horizon and classified by Neural Network. This allows to visualize zones of different quality. It is possible to use the probabilities linked to the different classes to estimate the uncertainty in ms. The final step is the setup of the above-mentioned structural framework based on the seismic horizons and the faults. Uncertainty in the horizon-fault line may have a dramatic impact on the Allen diagram that delivers the juxtaposition of the reservoir against reservoir/non-reservoir across the fault. In summary the development and improvement of new seismic 3D attributes and new structural modelling techniques allow the mapping of seismic horizons with increased accuracy.