Enhanced Imaging of Complex Structures to Reduce Uncertainty in Fault Interpretations - A Case Study from a Transtensional Area in Onshore Abu Dhabi

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Abstract

OBJECTIVES Identification of complex faults is a challenging task using traditional seismic interpretation techniques. Conventional discontinuity based seismic attributes has often limitation to delineate complex fault patterns in strike-slip and compressional tectonics regimes. This study aims to reduce uncertainty in fault interpretations by establishing a different approach to characterize the complex set of en-echelon and reverse faults using fault likelihood attribute which helped to produce better imaging of subsurface faults geometries and to identify subtle faults, which have a big impact in reservoirs communication and in the placement of horizontal wells. **PROCEDURES** Fault likelihood attribute is based on structure-oriented semblance (Hale, 2013) and it helps to detect faults as a change in reflector coherence as compared to the typical discontinuity-based attributes which identify only visible discontinuities/offsets in a set of seismic reflectors. This study explores the capability of the fault likelihood attribute to detect complex en-echelon faults in a transtensional area in Onshore Abu Dhabi where traditional discontinuity-based attributes often have limitations to characterize the fault patterns. Multiple scenarios have been assessed with varying parameters along the dip and strike of the fault planes to enhance the seismic imaging of the faults. **RESULTS** Fault likelihood attribute allowed to detect complex faults planes much more precisely compared to conventional discontinuity based seismic attribute volumes. In areas where faulting is subtle in nature, fault likelihood volumes were capable to detect “zero-offset” faulting and provided a better image to predict the location and geometry of the fault planes, which greatly aid to increase the accuracy in the fault interpretation process. The utility of the fault likelihood attribute is to expedite and improve the quality of the structural mapping to identify the potential transpressional (pop-up) and transtensional (pull-apart) structural styles at the seismic scale. The fault likelihood volumes have also been used as an initial reconnaissance tool to delineate the areas with increased risk of seal integrity due to an increased amount of faulting in the area both vertically and laterally depending on the geometry of the structures. **CONCLUSIONS** This novel approach using fault likelihood attribute volumes allowed us in detecting large and small-scale faults with a high precision and the results has been calibrated with borehole images in horizontal wells close to faults/lineaments. More accurate understanding of the location and geometry of the complex fault systems has helped to improve well placement strategy as it is well known that fault/lineament plays a critical role on flow between injectors and producers since fault typically induce flow anisotropy in the reservoir.