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Utilizing 3D Seismic Volume Attributes for Fault Identification and Timing on a Large Structure in Saudi Arabia

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ABSTRACT

3D seismic was acquired over a subsurface anticlinal feature in Saudi Arabia. This anticline is bound on the west by an easterly dipping reverse fault, and on the east by a near vertical reverse fault. The original discovery well was drilled in 1971, and total depth was reached in the Ordovician Sarah Formation. Conventional production from the structure is from the Jurassic Arab D/Lower Fadhili, while unconventional gas potential has been identified in the Ordovician Sarah Formation. Horizontal drilling technology and multistage fracturing techniques have been successfully utilized to target the Sarah Formation. Therefore, having an understanding of fault distribution and magnitude is important to the success of the unconventional drilling and completion program. Utilizing sonic and checkshot data, synthetic seismograms were created for the discovery and additional relevant wellbores. Seven significant seismic reflectors from the Jurassic to the Ordovician were interpreted. Isochrons were generated between each horizon to provide valuable insight regarding the timing of the structure. Grid-based curvature mapping was applied to these surfaces to aid in delineating the edges of the structure. Various volume attributes were calculated and the attribute workflow that effectively highlights major faults was selected. It was found that by utilizing an edge detection method, the faults were effectively highlighted. With a baseline established, subtle faults on the volume were then identified with confidence. Attributes were extracted from the volume at each of these seven horizons, and the seven stratoslices through the variance volume were compared to effectively analyze the complexity and history of the faulting. Fault planes were extracted from the volume and plotted on a stereonet. By utilizing satellite imagery, a wadi with agricultural operations could be viewed and overlain on the different stratoslices and their respective attributes. This wadi correlated with a portion of the 3D seismic that had poor quality data, which was causing the attributes to falsely identify faulting. This area of the 3D seismic was cropped and automatic fault planes were extracted from the volume. The newly resolved fault plains were plotted on a stereonet to identify three separate fault trends with confidence and highlight additional potential fault trends.