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Extracting, Understanding & Utilizing Azimuthal Anisotropy Through Depth Imaging

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ABSTRACT

We present a seismic processing workflow in which we demonstrate the value of enhancing full-azimuth, single-sensor, single-source (S4) seismic data by firstly regularizing the recorded wavefield to discrete offsets and azimuths whilst honoring the originally acquired data density, offset distribution and azimuthal sampling, followed by depth imaging in which we utilize standard and novel methods for near surface velocity model building and statics handling based on several UAE data examples. We will also show how the application of these new processing workflows to S4 UniQ 3D land seismic data have also highlighted the presence of previously undescribed azimuthal anisotropy, which we believe to be prevalent in the majority of producing fields in the UAE.

Any seismic imaging exercise requires the use of some sort of velocity model, whether it is simply applying moveout velocity prior to stacking, improving signal to noise and imaging through prestack time migration or through prestack depth migration. We argue that it is essential to have an accurate subsurface velocity model and to perform depth imaging before proceeding with any azimuthal analysis and further estimation of azimuthal anisotropy. The ability to record, process, characterize and correct for azimuthal anisotropy improves the fidelity of seismically derived rock physics properties, opens the opportunity for new fracture characterization and modeling workflows, and thus more accurate reservoir models.

The workflow we describe is designed to maximize the value of information that is extracted from seismic data acquired using single-sensor, single source technology. The information and attributes extracted may then be utilized with confidence together with borehole derived measurements for reservoir modeling, which may lead to reduced risk in well and reservoir planning and improvements in production.

We also present the specifically developed workflow from “Acquisition Design” to “Azimuthal AVO inversion ready data”. As measuring azimuthal variations was the primary objective it was important that any azimuthal bias was eliminated from acquisition and processing. This entailed recording a broadband, full-azimuth, single-sensor, single-source (S4) seismic survey, careful noise attenuation with signal preservation as the priority, regularizing the recorded wavefield to discrete offsets and azimuths followed by depth imaging.