Full-Azimuth Fracture Characterization

A Paradigm Geoscience Data Service

The pursuit of a full description and understanding of the geomechanical properties of fractured reservoirs has accelerated the development of new seismic imaging and characterization procedures. To recover and characterize fracture orientations and intensities, geophysicists must be able to model them from their amplitude or velocity behavior as a function of azimuth. These variations are described by a variety of anisotropic models with different approximations.

Traditional, seismic-based approaches for imaging fractures often rely on sectoring or groupings of seismic data based on their acquisition (source to receiver) azimuth. Unfortunately, this process under-samples, poorly samples, and averages the data, compromising the seismic signatures required to accurately measure fracture and stress orientation and intensity.

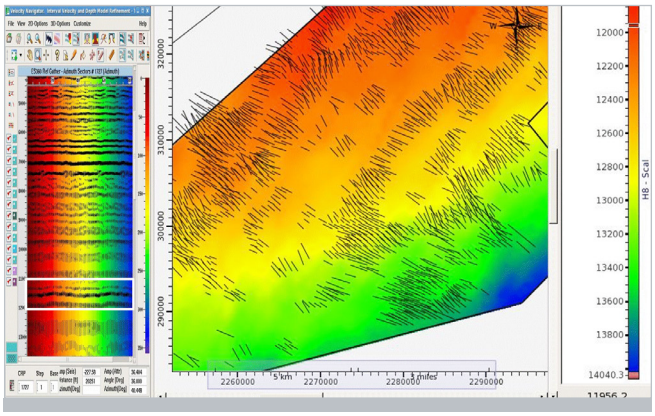
To significantly improve on these traditional processes, a new procedure for the seismic imaging and characterization of fractures has been developed by Paradigm. This procedure performs five-dimensional (5D) decomposition and imaging of surface recorded seismic data, in situ, in depth, and over all azimuths and angles. This game-changing "full-azimuth" imaging and characterization procedure has been demonstrated to measure fracture anisotropies with the highest levels of accuracy and resolve the intensities and orientations of stresses and fractures required by reservoir geoscientists and engineers to plan their well programs.

Paradigm Full-Azimuth Characterization Solutions

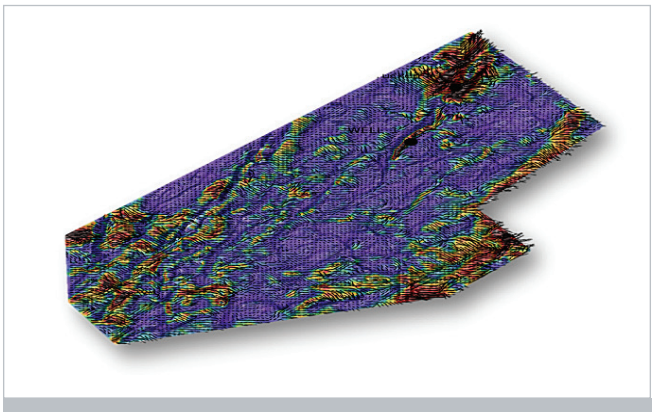
- Full-azimuth common reflection angle imaging for precision fracture determination, in situ and in depth (EarthStudy 360®)
- Full-azimuth residual moveout (RMOZ) and amplitude (AVAZ) inversions for independent collaboration and adaptation to different formations
- Fracture models described by HTI (horizontal axis of symmetry) anisotropy and tilted orthorhombic anisotropy
- Fracture maps and volumes of fracture density, fracture orientation, and minimum horizontal stress direction to fully describe the fracture / stress conditions of the target reservoirs
- Effective and interval parameter derivations of stress and fractures
- Applicable to fractured shales, carbonates and tight sandstones

Paradigm Full-Azimuth Characterization Advantages

The Paradigm Geoscience Data Services team is able to map fracture intensity and orientations at a higher directional and temporal resolution than industry-standard approaches using sectoring procedures. Based on patented full-azimuth imaging and inversion procedures, Paradigm is able to help oil and gas operators minimize risk and reduce costs associated with well positioning and planning by analyzing in situ seismic measurements with high correlation levels to fracture properties.



▲ Full-azimuth common reflection point gather from an Eagle Ford Shale dataset recovering 1% anisotropy at a depth of 11,800 ft. Fracture and stress intensity and orientation map from full-azimuth residual moveout inversion. Data courtesy of Seitel.



▲ Co-visualization of fracture/stress intensity from full azimuth inversion and fracture imaging from the Coherence Cube attribute. Data courtesy of Seitel.

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