Delivering HD Images from the Surface to the Deep Subsurface

An advancement in higher-resolution imaging is largely made possible by broadband and full-azimuth acquisition and processing, allowing operators to see finer features more clearly.

BY RICHARD EPERJESI, PARADIGM

Ultimately, oil and gas operators need to reduce risk and uncertainty in drilling decisions. To make those decisions with higher confidence, E&P companies need a clearer understanding of the subsurface in both legacy and modern seismic surveys. Therefore, it's critical to see important smaller features, such as fractures, thin beds and small faults, with high-definition (HD) seismic images.

In the Paradigm 14 release, significant enhancements were made in the seismic processing and imaging solutions, including Echos, GeoDepth and EarthStudy 360, for delivering multidimensional HD images from data acquired in deepwater, shale resource plays, fractured carbonates and structurally complex regimes. The advancement in higher resolution imaging is largely made possible by broadband and full-azimuth acquisition and processing, allowing operators to see finer features more clearly.

HD images require the ability to clean up field data by correcting source and receiver location inaccuracies, by removing low-quality or dead traces and records, and by improving the signal-to-noise ratio. New processing techniques like 5-D regularization have reduced acquisition limitations at the surface, while deghosting and other algorithms have improved signal quality. Advanced migration algorithms, such as reverse time migration (RTM) or the proprietary Paradigm amplitude-preserving, full-azimuth, angle domain migration, are able to better image complex geology such as near salt flanks. All of these changes have meant that interpreters can extract much more insight from their data.

Within the process that spans seismic processing, veloc-ity determination and seismic imaging, there are three challenges that geoscientists must overcome and where Paradigm 14 provides new functionalities.

Acquisition limitations
Using EarthStudy 360 Illuminator, the interpreter can understand any limitations in seismic surveys at the surface, while 5-D regularization allows mathematical repositioning of surface data into a more regular and desirable geometry.

Improving the signal
Broadband processing capabilities, such as deghosting, Q compensation, spectral balancing and deconvolution, enable increased amplitude and broadened frequency content for conventional towed streamer acquisitions. Particularly, deghosting removes unwanted interference and enables legacy data to be reformatted for HD. As a result, the interpreter can enhance fracture determination from seismic data with improved full-azimuth imaging and inversion methods.

Positioning subsurface geological features
A rich 3-D environment enables the display of residual moveout curves along a massive amount of gathers. Calculated moveout attributes aid the interactive quality control tool that allows the filtering of outliers according to predefined thresholds. This results in higher quality input into tomographic updates and more accurate velocity models. Advanced migrations, like Echos RTM and EarthStudy 360 CRAM, can then position events correctly. As a result, geoscientists can better understand the subsurface complexity. ■