While 3-D seismic acquisition and processing are routinely cited as significant breakthrough technologies that have impacted oil and gas exploration, broadband seismic acquisition and processing have the potential to have a similar impact on the exploration and development of oil and gas fields. However, just like the rapid acceptance and adoption of 3-D seismic acquisition were predicated on the availability of supporting technologies like 3-D seismic migrations and 3-D interpretation and modeling systems, the true value of broadband seismic acquisition and imaging will not be realized without complementary technologies and systems.

Broadband seismic acquisition and processing procedures also have migrated to onshore acquisitions with high-density acquisitions and point source-receiver deployments. The result? A wealth of new and greatly enhanced “high-definition” images are quickly coming online ready for high-resolution interpretation, characterization and modeling. But are the available interpretation and modeling systems equipped to fully take advantage of the information contained in these high-definition images?

Broadband seismic images are capable of recovering a level of structural and stratigraphic detail not present in standard seismic images, but recovering this detail is not straightforward with conventional interpretation and modeling systems. Time constraints coupled with less than optimized automated or computer-assisted picking methods generally result in an “underinterpreted” and “undermodeled” dataset.

New processes that move from surface-based to full volumetric interpretation and modeling solutions are now essential for fully optimizing the value of broadband seismic acquisition and processing. By doing so, the industry can address a number of limitations in the interpretation and modeling of reflector-rich datasets:

- **Unrestricted interpretation.** The interpreter has the freedom to add as many faults and interlayer reflectors as desired to the interpretation dataset without loss of time and without compromises to the stratigraphic model;
- **Solving the correlation challenge.** Interpreters do not lose time correlating stratigraphic horizons across heavily faulted datasets;
- **Validation.** By constraining the interpretation with 3-D chronostratigraphic modeling, interpreters can validate the data (horizons and faults) and the mapping potential enabled by the automated volumetric procedures without loss of time; and
- **Discovery.** By displaying and carrying out the interpretation on chronostratigraphic (depositional) slices, interpreters and modelers can augment it with unprecedented levels of stratigraphy and facies information not easily secured using standard seismic flattening procedures.

This new type of volumetric interpretation that merges automated volumetric interpretation and chronostratigraphic modeling procedures provides an opportunity to secure a higher return on investment from the high-definition images generated by broadband seismic acquisition and processing. Simultaneously, it forces the interpretation and modeling workflows to merge so their detail and complexity are proportional to the detail and resolution of data recovered using broadband methods. This merging also suggests that modeling technology must support cell resolutions that are coincident with those of high-definition seismic images. Consequently, interpreters and modelers must be able to easily work with giga-cell models to fully enjoy the resolutions of broadband seismic data.

Broadband seismic data are also an impetus for a new generation of quantitative seismic interpretation (QSI) solutions that drive a more unified and concurrent approach to transforming seismic amplitude data to elastic and rock properties. Success for these systems will be measured by how effective volumes of prestack interpretation can be integrated in the interpretation environment and how rapidly compute-intensive functions like seismic inversion can be carried out using all available multicore processors—CPUs and GPUs—at the desktop. Here, even fast voxel visualizations and rendering are essential components of a QSI system in pursuit of high-definition prospects.