Getting Closer to the Reservoir with Rock Physics Integration

Recent acquisition adds capabilities and data atlases to company's portfolio.

CONTRIBUTED BY PGS

Following the recent acquisition of the main assets of Rock Solid Images (RSI), PGS is adding rock physics, real-time seismic amplitude versus offset (AVO) modeling capabilities, and data atlases to its portfolio. The combination of GeoStreamer technology with RSI rock physics tools and atlases offers significant benefits when integrating seismic with well data, for example in demonstrating AVO compliance. PGS will also use the technologies to reinforce its 4-D feasibility and modeling of rock properties, calibrating GeoStreamer seismic with conditioned well data and known production scenarios.

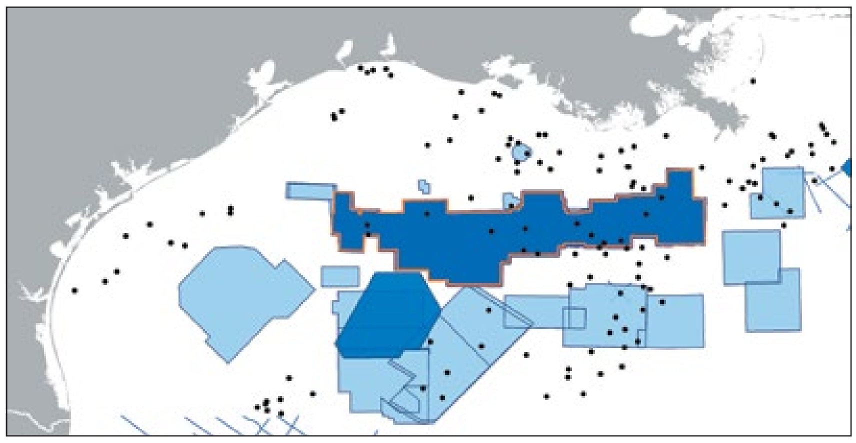
Executive vice president of New Ventures Berit Osnes says PGS will integrate well-based rock physics data in its MultiClient data library, offering the interactive rock physics atlas browser *rockAVO* as a MultiClient product. The current suite of rock physics atlases is a good fit with the PGS seismic data library, especially in the U.S. and Europe, with wells in the Gulf of Mexico (GoM), the Barents Sea, the Norwegian Sea, the North Sea and the U.K. Central Graben.

Unlocking reservoir properties

Rock physics is the link between seismic response and geological properties. It explains how rock properties like density, porosity and fluid fill influence seismic velocities and amplitude response at the well location.

Rock physics properties vary from basin to basin, and from stratigraphic interval to interval. For each, a separate model or rock physics template is required that relates seismic parameters to earth properties.

"PGS has ample access to the seismic side of this template. We've now added the geological part that comes from well data and a proven software tool to deliver fully interactive, well by well, rock physics-AVO modeling," Osnes says.



Overlap and integration of RSI well data with the PGS data library in the GoM is shown. (Image courtesy of PGS)

Expanding rock physics products in support of exploration

Regional *rockAVO* atlases for Europe and the GoM will be expanded to new areas, such as West Africa. At the exploration stage, combining regional rock physics atlases with seismic data library coverage will permit fuller and faster calibration of zones of interest and analog screening.

"Rock physics and real-time, dynamic seismic AVO modeling, with regional atlases and local studies targeting individual wells, will offer valuable additions to the PGS MultiClient product portfolio in key basins. This will enable our clients to carry out rapid screening for analogs and scenario testing of lithology, fluid, and porosity. New services will expand on established RSI workflows and technologies," Osnes explains.

Calibrating well data to 4-D seismic

Matching 4-D well modeling to 4-D seismic will offer further proof of the AVO compliance and imaging integrity of PGS seismic data.

4-D well AVO modeling can be integrated with seismic gathers, using the *rockAVO* interactive software, and PGS can now deliver enhanced 4-D feasibility studies and scenario modeling of reservoir characteristics, like saturation and pressure changes.

"Interactive AVO modeling enables rapid testing during both processing and interpretation, potentially improving the quality of project deliverables," says Allan McKay, vice president of 4-D Technology and Business Development.

QI advantage

The RSI acquisition will also strengthen PGS' quantitative interpretation (QI) capability, according to PGS' Global QI Manager Cyrille Reiser.

"Successful QI begins with an audit of available well log and seismic data, then data conditioning and rigorous quality control. The objective of QI is to estimate elastic seismic attributes within their proper geologic context. Rock-physics-driven QI techniques combining *rockAVO*, prestack AVO compliant seismic data and additional post-seismic inversion technologies will enhance the ability of PGS clients to predict rock and fluid type accurately during reservoir review and prospect analysis," he says.

"PGS has the finances and global reach to enable growth of these real-time dynamic rock physics products on a whole new scale, and the added synergies of the PGS data library mean this area has a very exciting future," Osnes says. ■

Deep Learning for Seismic Interpretation

Demonstrating the potential AI brings to seismic interpretation.

BY BEN LASSCOCK, ENTHOUGHT

An interpreter can transform a very limited set of labeled regions within a seismic volume into a 3-D model of the volume using an AI. Horizons are then automatically extracted across the 3-D volume, with 3-D metrics of uncertainty created to aid in the ongoing interpretation.

The first step to building the AI is to define a consistent "taxonomy" for what the interpreter plans to identify. In this example, the taxonomy includes a region bounding the salt, a chaotic zone, a clinoform and a set of continuous regions. We then took the F3 3-D seismic volume* and consistently labeled a small set of 5 inlines (<1% of the available data) according to this label taxonomy.

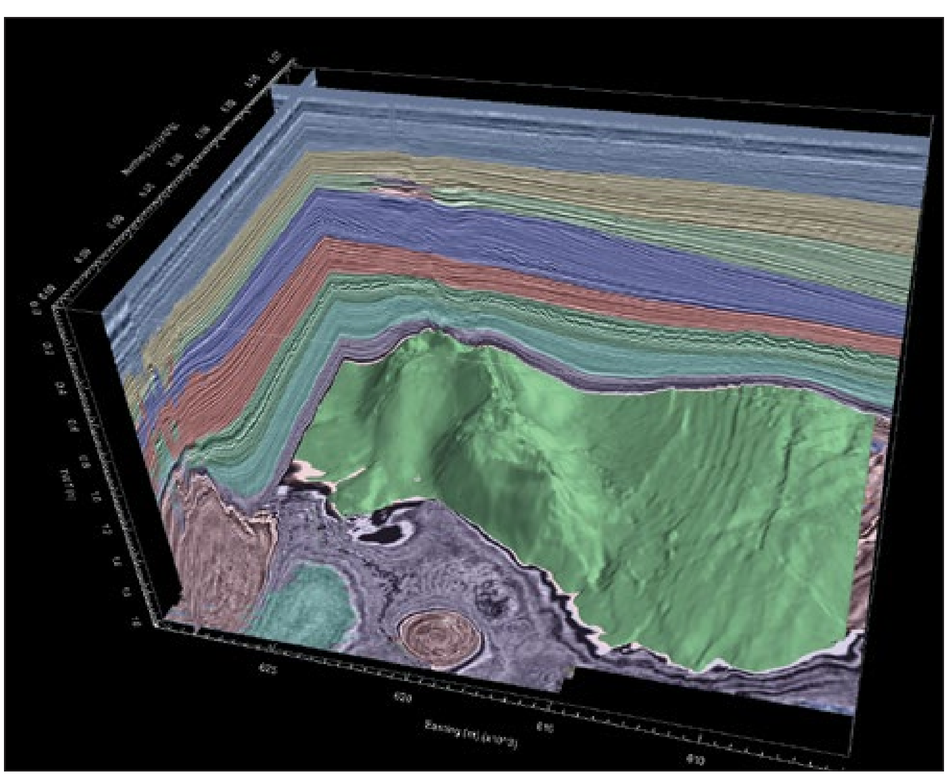
Next, we train a deep-learning model to replicate this interpretation given the subset of labeled inlines, then make a prediction across the entire volume. The output of this procedure is a collection of 3-D volumes, each containing the probability of a particular label. The most likely label is selected at each point in the volume.

We then iterate, correcting any errors we see on an additional set of 5 inlines that we use to continue training the model, making one 3-D final prediction. Note that very little work labeling was required after creating the initial model.

A horizon (in the associated figure) delineating the region bounding the salt is derived from the resulting label probability volumes and processed. No further human interaction was required to extract the horizon after retraining and prediction.

The accuracy of the technique and minimized use of expert time demonstrate the potential AI and deep learning bring to seismic interpretation.

Visit the Enthought booth to try out the technique. ■



This figure shows cross-sections through the F3 3-D seismic volume* with sequence labels predicted using an AI, overlaid in color. A machine learning method is used to derive a horizon on top of the "Salt" label, detailing the complicated geology immediately bounding the intrusion of the salt. The AI is initially trained by an interpretation on 5 inlines (<1% of the available data). An initial prediction is then made on an additional 5 lines; any errors are corrected, and the AI continues training on the updated lines. Horizons are then extracted automatically from the resulting 3-D volume(s) of predicted label probability. **The F3 3-D seismic volume was obtained from the "dGB Open Seismic Repository" and used under the Creative Commons (3.0 BY-SA) license. Augmentation of this data using deep learning is a derivative work and is made available under the same license.*