Economics Matter: Beyond Dots in the Box

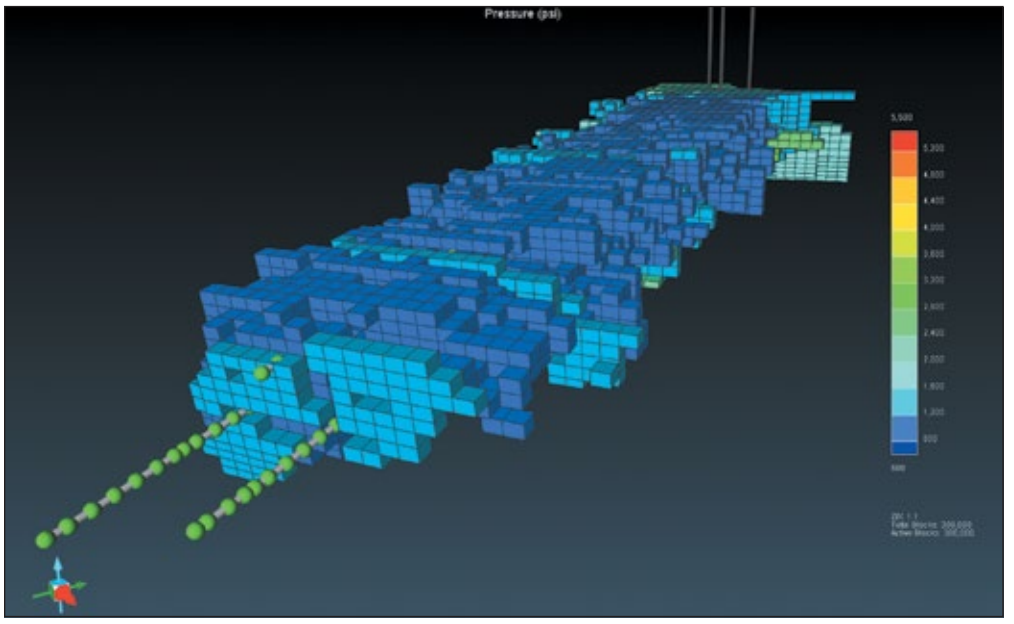
Microseismic-based model and data analytics platform maximize the ROI of the pad.

CONTRIBUTED BY MICROSEISMIC INC.

The last few years at MicroSeismic Inc. have been spent working to understand customers' challenges and to help them achieve their biggest goal—generating positive cash flow. MicroSeismic helps them increase drainage volume and drive costs down via well spacing, well configuration, effectiveness of the frac, treatment order and treatment design.

FracRx is the formalization of MicroSeismic's data analytics and synthesis platform by integrating multiphysics data to derive a prescriptive solution for improved well economics, maximized drainage volume, optimized completion and risk mitigation. This solution helps customers increase their net present value (NPV) and return on investment (ROI).

The example below shows how FracRx was applied to three wells drilled in a dry gas reservoir in the Appalachian Basin of the Geneso/Marcellus formations. The paramount objective of this project was to estimate the extent of the fracture network, evaluate the communication between wells, and examine the current state of well spacing. Understanding the volatility in gas price, MicroSeismic took the project one step further and performed an economic and sensitivity analysis on the well spacing and pattern to find the solution that would maximize the NPV of the pad.



A 3-D view of pressure distribution shows how the optimal well placement leads to effective drainage of the reservoir after 30 years of production. (Image courtesy of MicroSeismic Inc.)

Modeling production behavior

One of the major challenges in reservoir modeling in unconventional reservoirs is determining the dynamic drainage volume. MicroSeismic addressed this challenge through the application of a microseismic-based permeability model. The permeability model, derived from microseismic data, enabled the company to accurately calculate the evolution of drainage volume and to evaluate the communication between wells through time. Integrated with available well log, core and pressure-volume-temperature data, the reservoir model was calibrated to model gas production using three years' worth of production data. The production forecast was carried out to calculate the estimated ultimate recovery (EUR), which is a direct measure of the long-term success of the project. The extension of drainage volume far beyond the vicinity of the wells suggested that an increase in well spacing could benefit the production. While this may be true, the increase in well spacing could lower the production per acreage, leading to a loss in the overall economics of the project. Therefore, a comprehensive sensitivity analysis was performed to determine the impact of the well spacing on the production and economics of the pad. In addition to the current completion plan and after a thorough study of the drainage volume, a new completion pattern was proposed to improve the production of the pad and to lower the drainage zone overlap detected during the stimulation and production of the pad.

Economic approach to optimal well spacing

A sensitivity analysis conducted on the well spacing and pattern shows the significant impact of the completion design on the success and economics of the wells. The reservoir modeling shows that communication between wells declines with an increase in well spacing. However, it is capped to a certain limit where further increase does not impact the communication. Well spacing wider than 1,200 ft (366 m) for the original completion and 800 ft (244 m) for the proposed chevron pattern does not show communication between wells for this project. Although the overall production of the pad increases with wider well spacing, MicroSeismic did not recommend an increase in the distance between wells due to the growth in the size of undepleted zones. Pads with tighter well spacing consistently perform better compared to wider well spacing when the maximum production per acre and NPV per acre are targeted. The completion pattern and well spacing are not the sole factors in the success of the project; the analysis shows that the gas price drastically impacts the economics of the project. Using these

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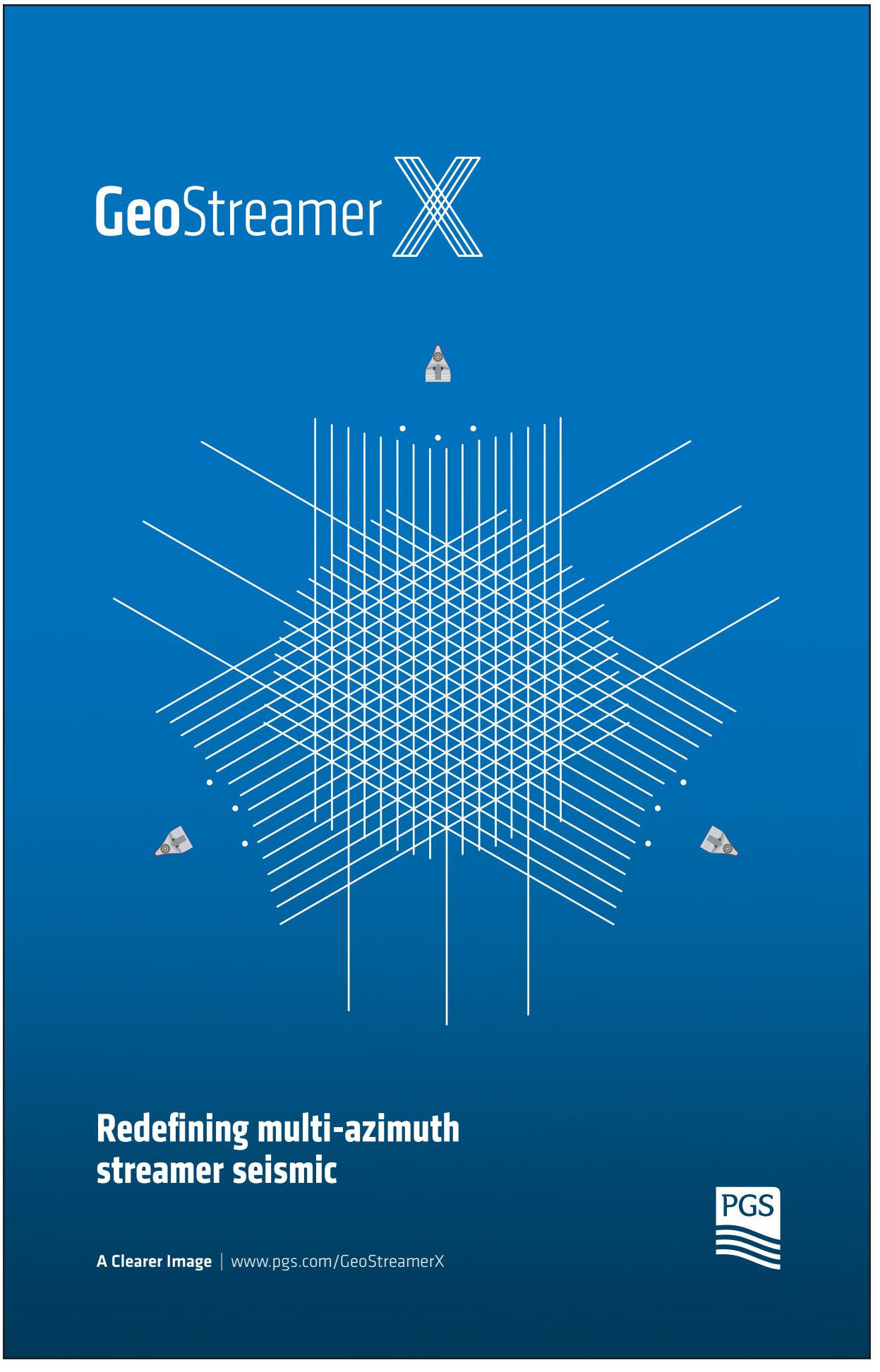

SOLUTION
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suppressed by the combined up-going and down-going wavefield deconvolution and the wave-equation multiple prediction.

Dual datum PSTM: In view of the problem of big elevation differences between shots and the receivers in deepwater OBN acquisition, this method deals with the asymmetry by calculating the travel time at different datum and simultaneously performing the conversion of velocity and imaging time of different datum.

Mirror migration: It uses first order receiver-side ghost to obtain better images, which gives better illumination than that by up-going primary wavefields, especially for the shallow layers, and can effectively solve the imaging error for the seabed and subsurface caused by the sparse distribution of the receiver in the OBN acquisition.

BGP's integrated solution for OBN data processing has been applied in different areas. ■

ECONOMICS
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wells as an example of optimum well spacing and pattern demonstrates that when the price of gas increases from $2/Mcf to $3/Mcf, the payback period of the initial investment drops from one year to only six months, which could be a major factor in evaluating the success of the project.

Maximizing NPV in real time

MicroSeismic has introduced a sophisticated approach for completion design aiming to improve frac efficiency and to achieve large stimulated volumes with the expectation of achieving increased EUR and NPV. Yet, no matter how sophisticated the completion design is, it simply cannot accurately predict frac hits, which can significantly impact how efficiently wells are getting completed. The only way to minimize frac hits, ergo higher frac efficiency, is by real-time monitoring of fracture propagation and their corresponding microseismic events, which allows for a prescribed solution that helps operators achieve the highest possible NPV on individual wells and ROI on the entire pad.

MicroSeismic Inc. provides an advanced economic solution to attain profitability through the integration and evaluation of all available data. Visit booth 3634 on Tuesday, Sept. 17, at noon for the Lunch and Learn, "How FracRx Helps Increase ROI," presented by Peter Duncan, CEO of MicroSeismic Inc. ■

CHALLENGE
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When combined with the 4D Reservoir Monitoring add-on, the 3-D geomechanical models become inherently 4-D, allowing asset teams to explore the impact of production-related changes on existing and future infill locations such as borehole stability and overall integrity. Geomechanical attributes that are sensitive to production can then be clearly tied to 4-D seismic responses, improving confidence in this complex interpretation task.

In addition to Geomechanics workflows, RokDoc 6.7.0 continues to see focus on usability, with new features around well data loading providing significant ergonomic improvements. In the Pressure Prediction Module, updates to the Pressure Translation Tool now allow users to translate pressure data to new offset or prospect locations across multiple wells simultaneously, reducing the need for repetitive tasks.

Ikon Science will also introduce direct two-way connectivity from iPoint to RokDoc 6.7.0 and the Petrel platform through the Petrel adaptor, allowing users to easily transfer all of their wellbore-centric data between the three platforms, thus providing an innovative solution for capturing, standardizing, and delivering important interpretive results to and between geoscientists, laboratory technicians and engineers across their organization.

At SEG this year, the Ikon team will be delivering six oral conference presentations as well as chairing several technical sessions. These presentations, along with a number of additional technical, solution-focused booth talks from both Ikon and industry guest speakers should make for a very exciting and informative convention. ■

Future SEG Annual Meetings

2020
11-16 October 2020
George R. Brown Convention Center
Houston, Texas USA

2021
26 September–1 October 2021
Colorado Convention Center
Denver, Colorado USA

2022
11-16 September 2022
Kay Bailey Hutchison Convention Center
Dallas, Texas USA

2023
5-10 November 2023
Ernest N. Morial Convention Center
New Orleans, Louisiana USA

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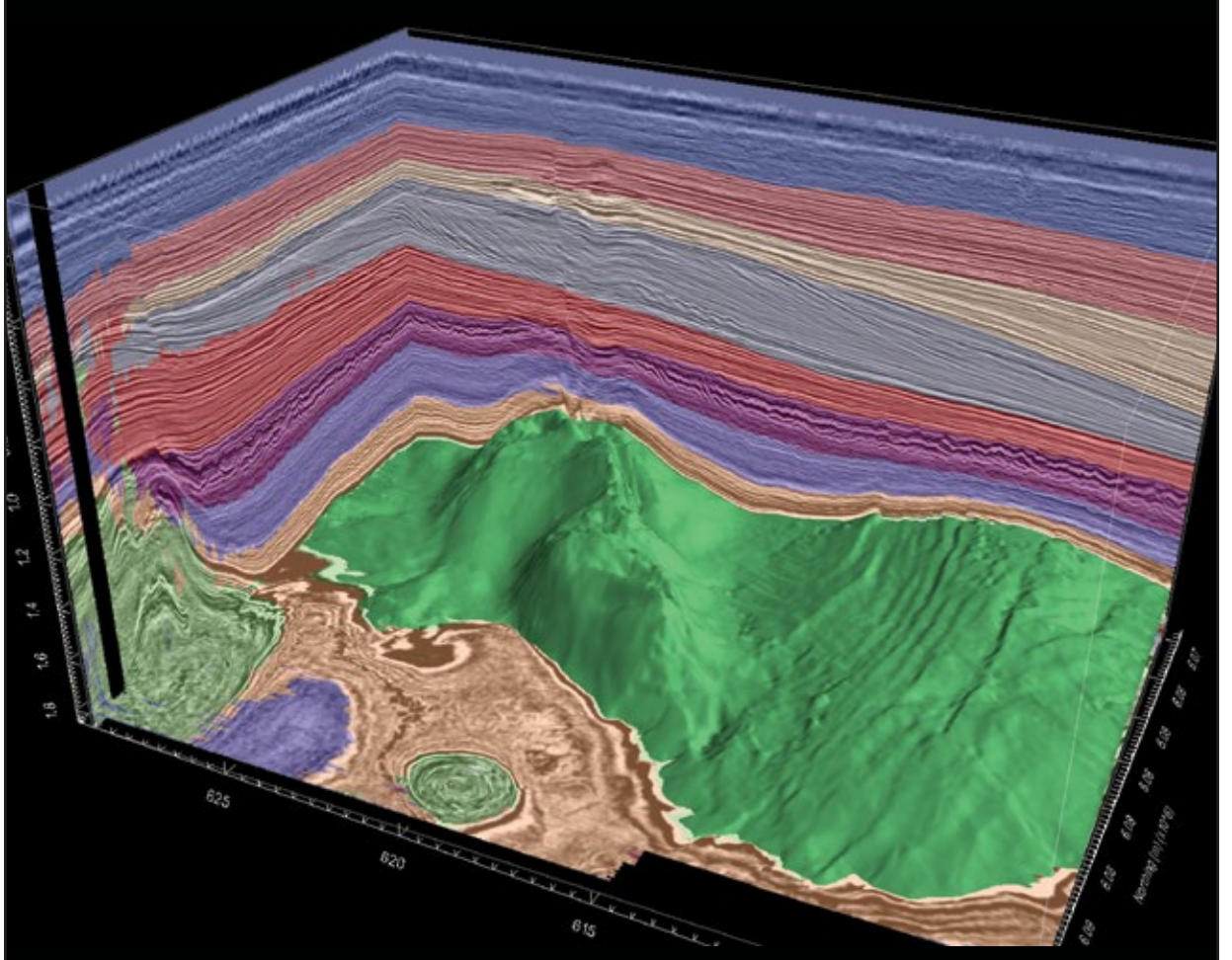
reservoir attributes from seismic attributes, such as prestack inversion results and amplitude, frequency and phase volumes. Two decades on, "deep learning" technology has now been added to Emerge to improve reservoir property prediction using deep feed-forward neural networks, which is producing an uplift in results compared to the previous generation of techniques.

As well as offering the latest technology in its new releases, CGG GeoSoftware is migrating its software to the cloud to provide greater opportunity for collaboration. The cloud offers more than just data storage—cloud computing provides scalable and flexible solutions to compute-intensive reservoir characterization workflows and very large projects. Through technical collaboration with Microsoft, the latest GeoSoftware releases run seamlessly in the Microsoft Azure Cloud Environment. Other major cloud platforms will follow soon.

To get the full picture, join CGG at 3:30 p.m. Tuesday at booth 3347 for a presentation on machine learning with Brian Russell, then stay for a Happy Hour discussion on GeoSoftware's roadmap to the cloud and a live software demonstration in Azure. ■

Let's Train a Deep-Learning Model Together.



We are calling on seismic experts attending SEG.

Visit our booth to classify open source seismic data. It's a big challenge to characterize that much data in just 3 days, but with the power of deep learning, NVIDIA, Dell Technologies and Enthought's new labeling tool, we can make it happen.

Join us at **booth # 2445** and let's roll up our sleeves and get to work. We'll send you the results after the conference.

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