Advanced Diffraction Imaging for High Resolution Interpretation and Fracture Characterization: Getting the Most Out of Seismic Data in Unconventional Plays
Monday, 10:15, Tuesday, 4:00
Presented by Gaby Yelin

- How relevant is seismic information to your plays?
- Do you consider diffraction weighed energy as a valuable contributor to understanding your reservoir?
- Do you have the right technology to deliver and integrate results?

Understanding the stress regime and natural fracture systems is of great importance to engineers aiming to accurately design well trajectories based on their drilling strategy. Seismic data has proven to play an important role in extracting such information, and appears to be of increased usage in unconventional plays, as a way to understand reservoir properties away from the wellbore.

Most of the available technologies related to fracture characterization are based on specific assumptions and azimuthal resolution limitations, which may cause inconsistency between the results of seismic data and observations from existing wells or during drilling. In this presentation we will discuss the advantages of working in the Local Angle Domain. Using this approach, the analysis of fracture characterization results in reliable information, as it is performed in situ and in depth, with minimal assumptions and honoring geophysical rules.

This technology enables the interactive analysis of full or rich azimuth prestack data. It generates two different types of stacks, specular weighted and diffraction energy, with the aim of providing valuable information that will increase interpreters’ confidence in their understanding of subsurface constraints. Specular reflection stacks are high-quality poststack volumes that emphasize the continuity of major seismic events (horizons and major discontinuities). Diffraction energy, which is largely lost during processing, as most imaging algorithms fail to separate the different wavefields during the summation process, can be associated with small scale features and fault systems at the reservoir level.

The different attributes created using this technology may be crucial to engineers when the time comes to design well trajectories for optimizing production, while providing better control of potential risks.

In this presentation we will share examples and case studies from around the world, including the Eagle Ford and Barnett Shales.

Supporting Technologies: EarthStudy 360®, SeisEarth®

Precision Re-depthing: Efficiently Matching Seismic to Wells in the Depth Domain
Monday, 12:15, Tuesday, 2:00
Presented by Gaby Yelin

Seismic-to-well mis-ties are a major challenge for geoscientists. This scenario is encountered quite often; even if the velocity model was built through a velocity-depth imaging sequence, mis-ties between well and seismic information are very common. The industry has adopted different workflows in order to overcome this challenge and adjust the seismic and interpretation data to honor well information through a velocity calibration process. The problem is that the majority of the techniques applied to velocity-well calibration do not honor the basic assumptions of seismic velocity model building. Therefore, the gather’s flatness may not be maintained, and non-geological velocities with artifacts may be generated. In addition, some of these workflows can be quite human intensive.

In this presentation, we will demonstrate one of Paradigm’s innovative technologies for velocity calibration and seismic-to-well matching, with powerful features but a very simple and user-friendly workflow, only mis-ties maps and velocity field are required. This technology, known as well data constrained time-preserving tomography, provides a reasonable solution to this challenge which honors the physics. This system also provides an approach for isotropic to anisotropic model conversion.

During the presentation we will explain the technology and share some examples and case studies.

Supporting Technology: SKUA-GOCAD™

Integrated Petrophysical Interpretation Helps Unlock Unconventional Reservoirs
Monday, 1:00, Tuesday, 3:15
Presented by Constantine Vavourakis

Unconventional shale reservoirs are once again becoming a focus of the energy industry in the US, despite, or perhaps because of the economic climate stemming from the current price of oil. Energy companies are acquiring more acreage in hot spots like the Eagle Ford or the Permian Basin. Regardless of the intrinsic differences between one fine-grained reservoir and another, most of the costs incurred in producing shale reservoirs come from completions and frac design.
More often than not, the bulk of production from a well is derived from a fraction of the frac stages. One way to reduce overall production costs is to design more efficient frac programs, focusing frac stages on facies that are more efficient to fracking. This requires an understanding of the distribution of mineral facies throughout the reservoir, along with the rock properties of those mineral facies. This presentation will show an optimized petrophysical analysis of multiple wells, estimate TOC, and finally look at estimating rock properties such as Young’s Modulus and Poisson’s Ratio, and how mineralogy influences these rock properties.

Supporting Technologies: Geolog®

Accurately Pick and Correlate Well Markers, Utilizing Real-Time Data from High Angle and Horizontal Wells
Monday, 2:00, Tuesday, 12:15, Wednesday, 11:00
Presented by Constantine Vavourakis
High angle and horizontal wells present a number of challenges to the operations geologist. Accurately monitoring and steering a horizontal well requires rapid correlation between modeled and actual log responses, while the correlation of specific horizons encountered during the geosteering process, with known markers from nearby exploration wells, requires a software package that is flexible enough to handle complex geological environments.

Geologist’s industry-leading Geosteering software is a vendor-neutral application for the correlation of modeled logs with real-time or recorded LWD data, in a dedicated geosteering display. Geologist's Correlator module gives unrivaled flexibility in marker correlation, using a well partitioning technique based on trajectory turn-points in either TVD or TST. The respective up and down sections can then be correlated with any nearby wells in the same correlation panel. An additional cross-section display shows the orientation of all wells in true space.

Utilizing these fully integrated modules, Geologist is able to provide the geologist with a deeper understanding of the interrelationships that exist in challenging hydrocarbon reservoirs.

Supporting Technologies: Geolog® Correlator; Geolog Geosteering®

A Machine Learning Technique for Lithology and Fluid Content Prediction from Prestack Seismic Data: An Application to a Permian/Carboniferous Carbonate Reservoir
Monday, 3:15, Tuesday, 10:15, Wednesday, 11:30
Presented by Peter Wang
One of the leading challenges in hydrocarbon recovery is predicting rock types/fluid content distribution throughout the reservoir away from the boreholes. Spatial determination of the lateral and vertical heterogeneities has a direct impact on a reservoir model, because it affects the property distributions. An inappropriate determination of the facies distribution will lead to unrealistic reservoir behavior. Because these data can take different forms (lithologs, cuttings, and for seismic, poststack and prestack attributes) and have different resolutions, the manual integration of all the information can be tedious and sometimes impractical.

Paradigm has developed a new neural network-based methodology called Democratic Neural Network Association (DNNA)™. The DNNA method was trained using lithology logs from wells simultaneously with poststack and/or prestack seismic data. This technique, using a probabilistic approach, aims to find patterns in seismic that will predict lithology distribution and probability. The engineer will be able to differentiate between rock sub-types that cannot be easily resolved with conventional methods; sub-types that may matter to hydrocarbon productivity. An understanding of the probability of occurrence and spatial connectivity of key reservoir rocks will also be gained, allowing the drilling and completion budget to be spent more productively.

Supporting Technology: Rock Type Classification

Using Prestack Seismic to Understand Stress and Fracture before You Frac
Monday, 4:00; Tuesday, 1:00; Wednesday, 10:15
Presented by Peter Wang
Knowledge about the presence and orientation of fractures and stress is fundamental to shale operators. From a seismic point of view, P-wave seismic energy propagating across fractures will be influenced and slowed down because of microscopic opening and closing of fractures as the P-wave propagates. Stress also affects seismic velocities. A phenomenon known as “strain hardening” occurs when applying stress to materials; they strengthen in different directions, and their seismic velocity changes. Therefore, seismic velocity will be different depending on the azimuthal orientation of the seismic wave.

We can measure these azimuthal velocity changes using azimuthally diverse prestack seismic data. We will show how we develop 3D spatial estimates of horizontal anisotropy caused by fractures and stress on an Eagle Ford example from Seitel using AVAZ and VVAZ technology. The economic benefit of this is that the engineer will be able to allocate the finite completion budget to rock mostly likely to develop complex, richly-connected fracture networks. This will reduce the costly occurrence of large numbers of stimulated but ultimately non-productive intervals.

Supporting Technologies: QSI for Reservoir Geophysics