SEISMIC ATTRIBUTES AS THE FRAMEWORK FOR DATA INTEGRATION THROUGHOUT THE OILFIELD LIFE CYCLE

Instructor: Kurt Marfurt

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While lower in vertical resolution than well log and core data, 3D seismic data provide a more comprehensive image above, below, and at the reservoir than any other data source. For this reason, 3D seismic data and its derivative products form the natural framework for subsequent data integration for both static and dynamic earth models. In the exploration part of the oilfield life cycle, seismic data and seismic attributes image horizons and delineate faults. While interpretation in the exploration stage is necessarily qualitative, it is based on scientific principals of stratigraphy and structural geology. Attributes illuminate architectural elements that help determine the depositional environment, while small faults and flexures help determine the deformation process. In the development part of the oilfield life cycle, the addition of downhole measurements provides a means to become more quantititative. Correlation of image logs and microseismic events with curvature and azimuthal anisotropy help define areas that are more intensely fractured. Well log measures of P-velocity, S-velocity, and density coupled with rock physics data bases and systematics provide the basis for seismic impedance inversion, allowing the interpreter not only to evaluate direct hydrocarbon indicators but also to construct a geocellular model. Seismic data plays a lesser role In the mature part of the oilfield life cycle, where the goal is to extract the remaining oil at minimal expense. Legacy seismic surveys shot when the oil field was young may not contain the resolution needed to best understand subtleties in the mature oil field. Reacquiring seismic data is more common in large offshore reservoirs where significant resources remain. Here, time lapse attribute analysis provides the means to identify by-passed pay, sweep, flow barriers, changes in pressure, and potential geomechanical instabilities.

Mature fields can be reborn. Overlooked deeper and shallower objectives as well as new play concepts reinvigorate oil fields where the acerage is held and the infrastructure is in place. 5D interpolation reinvigorates legacy seismic surveys. In North America, technical innovations including horizontal drilling and hydraulic fracturing may directly target the source rock, or drill tight or highly heterogeneous parts of the reservoir too expensive to produce from vertical wells. Our analysis becomes more statistical, where the experience obtained from tens if not hundreds of wells can be correlated to volumetric attributes. Using core to generate reservoir-specific templates, seismic attributes can be statitically correlated to brittleness, total organic carbon, rate of penetration, and expected ultimate recovery.

In this one day short course, I will illustrate these concepts by example, showing modern workflows based on interactive interpretation and display as well as those aided by machine learning.

Who should attend?
Participants should have a basic understanding of sedimentology and structural geology and familiarity, but not necessarily expertise in 3D seismic interpretation. The accompanying textbook will include mathematical details of volumetric attribute calculation, image processing, and machine learning algorithms. The lecture will focus on fundamental assumptions, algorithm application, and analysis of the results.

Instructor Biography

Instructor: Dr. Kurt J. Marfurt
University of Oklahoma

Kurt J. Marfurt joined The University of Oklahoma in 2007 where he serves as the Frank and Henrietta Schultz Professor of Geophysics within the ConocoPhillips School of Geology and Geophysics. Marfurt's primary research interest is in the development and calibration of new seismic attributes to aid in seismic processing, seismic interpretation, and reservoir characterization. Recent work has focused on applying coherence, spectral decomposition, structure-oriented filtering, and volumetric curvature to mapping fractures and karst with a particular focus on resource plays. Marfurt earned a Ph.D. in applied geophysics at Columbia University's Henry Krumb School of Mines in New York in 1978 where he also taught as an Assistant Professor for four years. He worked 18 years in a wide range of research projects at Amoco's Tulsa Research Center after which he joined the University of Houston for 8 years as a Professor of Geophysics and the Director of the Allied Geophysics Lab. He has received the SEG best paper (for coherence), SEG best presentation (for seismic modeling), as a coauthor with Satinder Chopra best SEG poster (one on curvature, one on principal component analysis) and best AAPG technical presentation, and as a coauthor with Roderick Perez Altimar, SEG/AAPG Interpretation best paper (on brittleness) awards. Marfurt also served as the EAGE/SEG Distinguished Short Course Instructor for 2006 (on seismic attributes). In addition to teaching and research duties at OU, Marfurt leads short courses on attributes for the SEG and AAPG, and currently serves as Editor in Chief of the AAPG/SEG Journal Interpretation.

Course location:

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