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Abstract

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Uses, Abuses, and Examples of Seismic-derived Acoustic Impedance Data: What Does the Interpreter Need to Know?

Throughout the years there has been a concerted effort to integrate the geoscience disciplines to become more adept at understanding the potential of an area. In the 1980s, geophysicists interpreted 2D seismic data by overlaying log data on paper seismic sections and using generalized depth-to-time curves to determine which events represented markers on the logs. Geologists interpreted cross-sections by drawing straight lines between wells to represent their correlations. Because technology advances have changed the process, many people today have become "interpreters" of 2D or 3D data on workstations where the log data, seismic data, and many derivations of the seismic data (attributes, coherence, P impedance, inversions, elastic impedance, lambda rho, etc.) are available to fine-tune the analysis process. The question, however, still remains: Are we integrating the data yet?

Inversion of seismic data into acoustic impedance provides a natural tie to the log impedance data and forces the geoscientist, in analyzing seismic data, to extract appropriate wavelets, determine the phase and amplitude of the data, determine whether or not the phase is stable throughout the volume, and very intimately tie the well log impedance data to the seismic data. Utilizing inverted data at the beginning of the interpretation process requires that the geoscientist understand the rock properties in their target area before embarking on an "attribute" interpretation. Even when the P impedance data do not clearly distinguish between fluids or lithologies, value is added by using these data as the first interpretation tool. The simplicity in knowing that the change of values represents a change in rock properties without the complexity of wavelet variability is a distinct advantage to the interpreter. This initial process is critical to undertaking any interpretation of seismic data. Seismic data, being an interface property, contain tuning, side lobe effects, and phase and frequency variability, making it difficult to directly determine the geology. Inverted data, a layer property, are a more intuitive geologic tool that allows interpreters to utilize their natural ability to "see" the geology in the seismic data.

Today, advanced impedance tools use angle stack data and shear log components that can aid in distinguishing between lithologies and hydrocarbon properties. These data combine the benefits of angle data, AVO, and rock properties which—when analyzed together with the understanding of the depositional environments, stratigraphic concepts and the myriad of seismic attributes—can greatly increase the interpretative ability of the geoscientist.

This presentation will demonstrate the necessity for inversion and explain why it is beneficial in an interpretation workflow.

It will examine both the strengths and drawbacks of using inverted data as compared with the seismic data and the original rock data. It will also show the following:

- how scale differences between various data types can effect the results,
- how the interpreter analyzes the rock properties and utilizes these with inverted data and,
- how to spot pitfalls in the overuse of impedance data.

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Education:

1980 Boston College, MS Geology
1974 Framingham State College, MA
B.Sc Math, Earth Science, Education

Experience:

1980-1995	Amoco Production Company; USA, Geophysicist, Sequence Stratigrapher
1991-1992	Enterprise Oil Company; Stavanger Norway, Sequence Stratigrapher, Interpreter
1995-1996	Consultant
1996-2000	Jason Geosystems, Inversion technology application & Chief Geoscientist, Houston TX
2000-Present	Texaco, ChevronTexaco, Chevron Geoscientist & Team Leader for Stratigraphy and Geostatistics Services in Chevron's ETC

Professional Interests:

The evolution of seismic stratigraphy into seismic sequence stratigraphy over the years has necessitated a close tie between seismic data and log and core geological data. The scale differences, between these data, the quality variability and the analysis of phase, frequency and anisotropy of the seismic data complicate the process. There is a natural link between inverted seismic data and seismic sequence stratigraphic analysis but often these two disciplines are analyzed separately. When properly inverted and analyzed, the seismic data can yield rock properties, minimize the wavelet effects and allow for a more straight forward medium for interpretation. My interests, as a geologist and a geophysicist, lie in the integration of seismic data, inversion, rock properties, and well data into the sequence stratigraphic process as well as the quantification of the uncertainty inherent in interpretation of these data.

Publications & Awards:

From 2002 to Present: Editor Leading Edge, Interpreter's Corner
Authored and Co-authored numerous publications internal to Amoco and Chevron and external in SEG, AAPG and HGS

Memberships:

American Association of Petroleum Geologists
Society of Exploration Geophysicists
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