**Wednesday, October 27, 2004**

Petroleum Club • 800 Bell (downtown)
Social 11:15 a.m., Lunch 11:45 a.m.

Cost: $28 Preregistered members; $33 Nonmembers & Walk-ups

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by ***Dr. Heloise Lynn***
*Consultant*

**SEG Distinguished Lecture**

# The Winds of Change: Anisotropic Rocks—Their Preferred Direction of Fluid Flow and Their Associated Seismic Signatures

Although 20 years ago it was politically incorrect to admit that horizontal permeability anisotropy resulting from aligned connected porosity was linked with seismic anisotropy (azimuthal anisotropy), the winds have changed.

Our industry now has a respectable worldwide effort in research, acquisition, processing, interpretation and modeling that pursues precisely that linkage. The current thought process is that unequal horizontal stresses and/or vertical aligned fractures can provide the aligned, connected porosity that may result in horizontal permeability anisotropy. The presence of vertical aligned fractures and/or unequal horizontal stresses typically causes azimuthal anisotropy.

The earliest efforts pursued the azimuthal variation of PP and SS traveltimes and amplitudes, because these pure-mode seismic waves measurements are the "easiest" measurements our industry can process and interpret, and we believe we understand traveltimes and amplitudes. Thus our documentation of the relationship of azimuthal PP and split shear-wave measurements was founded.

As time went on, the PS modes (P-S1 and P-S2) or the split C-wave (converted wave—P down and S up) were used to document the shear-wave anisotropy arising from unequal horizontal stress and/or vertical aligned fractures.

Now, however, our industry is grappling with what researchers point out as the "biggest" anomaly that links horizontal permeability anisotropy to seismic anisotropy—azimuthal variation in attenuation. However, attenuation has usually received cursory dismissal. We don't like "dim zones" being "pay" because (1) they are "too hard" to map, (2) there are too many other reasons for dim zones rather than azimuthal attenuation and (3) attenuation is too hard to quantify and attribute to any one cause per se. In the past, we have often used trace equalization, AGC, spectral whitening and other very powerful processing techniques to remove dim zones. Processors worth their salt made those pesky dim zones look nice and bright and sharp!

*…our industry is grappling with what researchers point out as the "biggest" anomaly—azimuthal variation in attenuation.*

In the past, attenuation has been a classic problem and not a "solution" to anything. Now, however, we can glide forward on the next wave of multi-component, multi-mode, multi-azimuth 3D and 4D seismic powered by the winds of change.

### Biographical Sketch

**Heloise Lynn** started working in reflection seismic in the oil/gas industry in 1975, processing seismic data at Texaco, in Houston, Texas. In 1978, she completed her MS in exploration geophysics, Stanford University, and in December 1979, she completed her PhD in geophysics, also at Stanford University, in (post-stack) depth migration and interpretation issues within migration algorithms. From 1980 to 1984, she worked for Amoco in Houston. In collaboration with Leon Thomsen and Rusty Alford, she worked on shear wave splitting and anisotropy in SS reflection data. From 1984 to the present, she has been consulting on anisotropy, multicomponent and multi-azimuth techniques.

From 1981 onward, she has been working on recognition and use of S-wave splitting in reflection SS data (mid-1980s), using multi-azimuth and multicomponent data to characterize naturally fractured gas reservoirs (mid-1990s). In the mid-1990s, the U.S. Department of Energy funded three projects, wherein she served as principal geophysicist, to document how to use reflection seismic to characterize naturally fractured gas reservoirs. Her current interests include the co-rendering of high-dimensional seismic datasets for interpretation (mid-2000s). "Where you sit governs what you see," and two subsequent articles, by H.B. Lynn, Ping Chen and Chenyi Hu, in *The Recorder*, Canadian SEG, July 2003, discuss the visualization of high-dimensional datasets.