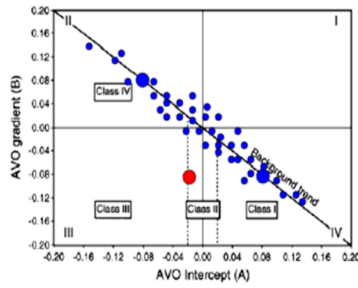
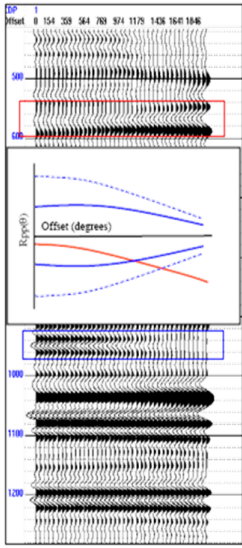


Pre-Stack AVO and Simultaneous Inversion

Pre-Stack Simultaneous Inversion is to delineate structural, stratigraphic and geotectonic framework of a block or a permit using data available.



Intercept: Contrast in acoustic impedance
 Gradient: Contrast in VpVs ratio

In the areas with less well control a true amplitude based AVO extraction is applied. Three methods are used to derive the results and are calibrated to local backgrounds. By carrying out AVO Attribute generation with multiple methods we minimize the risk of false positives.

- Aki Richard's equation** - Normal Incidence and Gradient
- Fatti's equation** - Fatti et al (1994) gave a formulation derived from Aki-Richards equation and is one of the best recognized method to detect AVO affects using Fluid Factor calculation.
- f-μ-p method** - Russell et.al. 2011 re-formulated the Aki-Richards equation to directly detect fluid, rigidity and density variation.

HR – Hampson-Russell software package

AVO Pre-conditioning

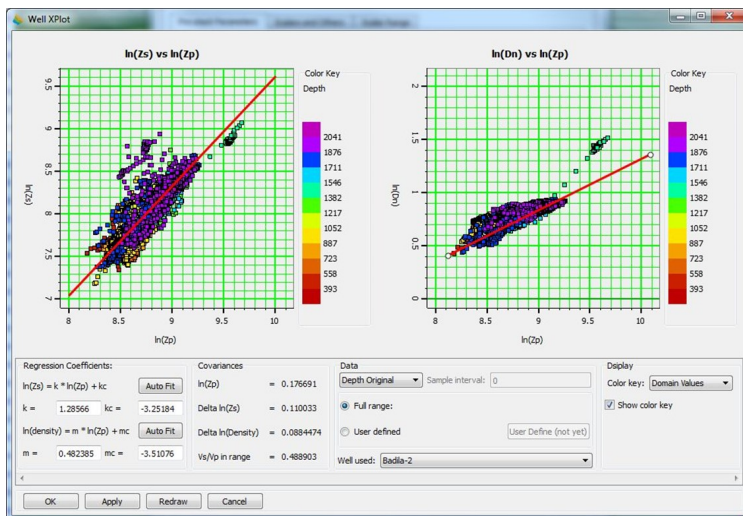
Pre-conditioning of the seismic gathers is one of the most crucial parts of the pre-stack inversion. The gathers contain various forms of noise and multiples. Generating super gathers can help improve S/N ratio. Offset dependent linear or exponential amplitude scalar can also help in improving the amplitudes at farther offsets. As the AVO Inversion process is based on the angles of incident, the offsets are converted to angles using well and seismic velocities.

Wavelet Analysis and Phase correction

Synthetic well tie to the seismic allows estimate of true seismic phase. Using all the available wells a progressive scan of the phase will be applied to determine the extent of shift from zero phase (if it exists). Checkshot and/or VSP data will be used at this point to further confirm correct seismic ties.

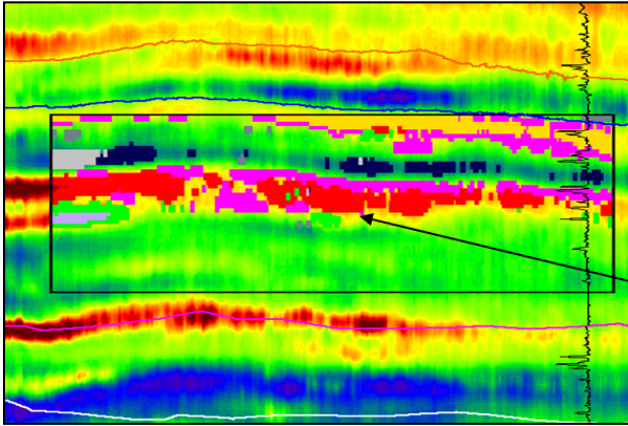
The gathers usually have changes in frequency with offset, the wavelet is estimated at near mid and far offsets separately. These three or more wavelets allow better full waveform inversion process.

Various windows will be tested to estimate the wavelet. As there are various targets the inversion process may be repeated based on the best estimated wavelet for each target zone. In addition, length of the wavelet also affects the results. Various single line tests will allow a better estimate of the wavelet. Shale impedance varies based on the mineral composition and diagenesis, thus affecting the elastic parameters.

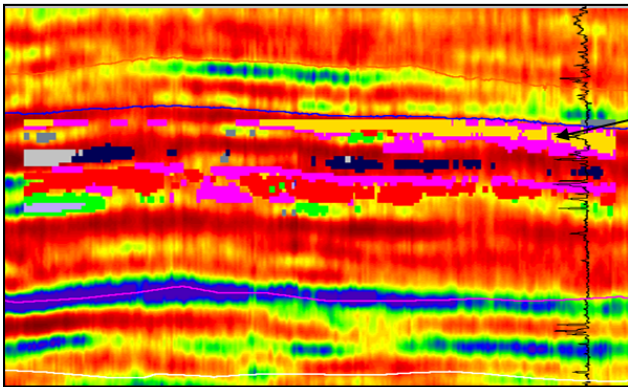


PRE-STACK SIMULTANEOUS INVERSION

Lambda-Rho (incompressibility)

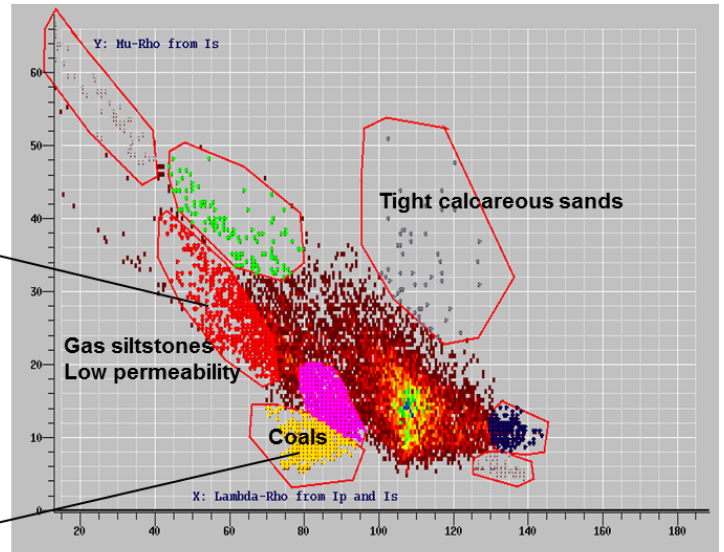


Mu-Rho (Rigidity)



Pre-drill analysis for well 12-10. Falher F and G sandstones with AVO effect

Mu-Rho (Rigidity)

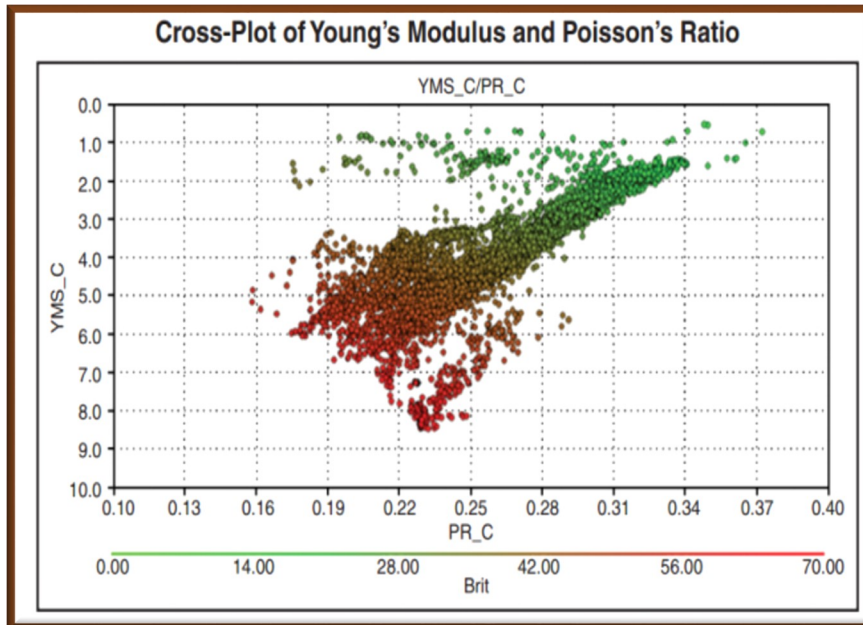


Lambda-Rho (incompressibility)

Lambda-Rho vs Mu-Rho x-plot do have physical meaning related to the rocks and can be derived seismically as well.

AVO/LMR – More definitive tool can be transformed more accurately to lithology and fluids

Cross-Plot of Young's Modulus and Poisson's Ratio



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