A Risk-Reduction Recipe Using Frequency-Based Pore Pressure Predictions from Seismic Data

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ABSTRACT

The more traditional approach to pore pressure prediction using seismic data is based on an analysis of stacking velocities. This velocity-based (V-based) approach is predicated on relationships between velocity, porosity, and the pore pressure of shales. These relationships are generally good, but they are contingent on a number of well-known assumptions; sometimes the results can be spectacularly wrong.

A newer approach is based on an analysis of frequency content. Frequency-based (or Q-based) pore pressure prediction is a patented technology based on an understanding of the relationship between frequency decay and effective stress. It is a fairly straightforward calculation which can be performed on stacked data. In areas where there are geopressures, fairly large volumes of data can be analyzed in a cost-effective fashion and important relationships may be discerned between the geometry of the pore pressure distribution, the structure of the rocks, and the accumulation of hydrocarbons.

Examples illustrate some of the more interesting relationships which are observed when examining pressure distributions over large areas. Pressure discontinuities across faults provide good evidence that, at least in the near term, the fault is sealing. Abrupt pressure changes at the base of regional shales may indicate their performance as seals. Hydrocarbon accumulations are oftentimes associated with local areas of high pressure; these local highs may indicate trap integrity over time, as the regional geopressure bleeds off. Conversely, local areas of low pressure may indicate the direction for present-day fluid migration paths; recent accumulations (possibly with charge problems) may reside in these areas.