

Heloise Lynn¹: (1) Lynn Incorporated

Azimuthal variations in PP reflection seismic: signals on in-situ stress fields &/or vertical aligned fractures

The uses of the azimuthal variations in reflection signatures, traveltimes, amplitude, gradient, and recently, frequency and Q, are growing in awareness amongst the worldwide community. Recent field data publications from the Middle East (fractured carbonates) and onshore North America have documented the practicality of the PP azimuthal measurements.

The presence of unequal horizontal stresses and/or vertical aligned fractures causes azimuthal variation in the seismic signatures. The regional in-situ stress field is documented in the World Stress Map (Univ. of Karlsruhe, Germany, website www-wsm.physick.uni-karlsruhe.de), which should be consulted early in a stress- or fracture-play.

Often, corroboration, and additional insights, from split C-wave (P-S) reflections accompanies the PP azimuthal signatures, if multi-component 3D (wide-azimuth) data are acquired.

The field data acquisition requires offset equal to target depths, for all azimuths, with fold at least 2 to 4 times that required to form a migrated image (that is, to pick velocities). Processing can be accomplished in a variety of methods, but the all-azimuth scanning technique has shown itself to work well. Interpretation requires the co-rendering of at least 3 or 6 numbers, for each bin, on one map, along with structure, faults, and preferably, curvature. SURFER, an off-the-shelf mapping package, is the best approach for this.