
Fracture Detection by P and C Wave Anisotropy from Multi-Offset VSP

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Fractures in carbonate reservoirs affects both the porosity and permeability. The characterization of fractures is therefore essential for successful exploration and production of the reservoir. Multi-component VSP data can identify fracture density and orientation by measuring the P and S wave anisotropy caused by the fractures.

Recently, a deviated well was drilled in a direction perpendicular to possible reservoir fracture orientation in the Qatif Field in Saudi Arabia. A multi-azimuth VSP was acquired for the purpose of characterizing the vertical fractures within the Arab and Lower Fahdili reservoirs. The VSP data consist of a total of seven offsets including two nearly orthogonal pairs. This carefully designed survey data provides an opportunity to employ different methodologies for the fracture characterization including: 4C-pseudo Alford rotation method, C-wave hodogram, and P wave travelttime analysis.

Analysis of the P-wave travelttime from symmetrical shot points and shear-wave hodogram provide a clear indication of fractures within the reservoir units. The prominent fracture orientation is confirmed by the rotation analysis of the orthogonal shot point data.
