Integrated Fracture Characterization Using Innovative Seismic Fracture Attributes and Seismic Inversion Results

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ABSTRACT

This paper describes an advanced methodology for fault and fracture detection using fracture oriented seismic attributes for a north Kuwait field. Derived attributes is integrated with available image logs, shear sonic, core data and with lithology prediction using pre-stack inversion for developing the fracture network. Wherever, full or wide azimuth data were available, azimuthal anisotropy results is utilized in validating the fracture network. The 3D discontinuity attributes included for the computation are volume curvature, coherency, edge, dip, and azimuth and dip azimuth. The understanding of the fracture network is often necessary for both exploration or production context, as it can be a key driver controlling the fluid movements. In case of highly fractured field, understanding of fracture network is quite useful in building reservoir models, while performing flow simulations and help in performing risk analysis for fault sealing issues. The first step in computing the fracture oriented seismic attributes is to separate geological discontinuities from random noise. A model-based seismic inversion helps reducing the noise content and this help unveil meaningful fracture response. Inter-bed multiple modeling is carried out to significantly attenuate the multiple contamination and some robust data conditioning processes are utilized for maximizing the resolution and reducing the random noise. Innovative 3D seismic attributes are derived for fracture detection utilizing different computation methods. Selected methods are very sensitive to discontinuities of the seismic signal. The obtained result relies strongly on the quality of the attributes. While analyzing the relevance of an attribute, its normalization is a key step. It allows achieving the best compromise between its accuracy and its noise level. Three different techniques to get rid of the structural effect have been used are 3D Dip detection technique, horizon-guided technique and wavelength filter technique. Innovative solutions to reduce the structural effect, lead to cleaner and finer attributes. These approaches allow generating advanced attributes for better imaging of the fracture network. The fracture index maps computed using this approach give a comprehensive and detailed picture of the fracture network. In this fracture study, the characterization of the fracture networks, at the different levels of the formation of interest, led to understanding of their vertical continuity.