Seismic Attributes: Leveraging Seismic Data for Reservoir Characterization: Fracture Identification and Prediction to understand seal integrity in the unconventional Eagle Ford Shale reservoir, South Texas, USA.

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Summary

Field observations and theory have shown that fracture distribution and geometry in sedimentary rocks is directly controlled by the geologic structure, stress regime, and mechanical rock properties. The purpose of this study is to identify deformation patterns from 3D derived attributes and to calibrate these attributes to fracture azimuth and fracture density calculated from a regional data set of image logs. This study incorporates both surface based (curvature, dip, dip azimuth) methods and volume based (coherency, similarity, etc.) to quantitatively predict fracture orientation and intensity. The area of study also coincides with an area where the Austin Chalk is significantly thinner and more pervasively fractured than in other areas in the trend and forms an inadequate top seal to effectively “trap” Eagle Ford generated hydrocarbons. This technique provides an explanation as to the presence of an area of anomalously low reservoir pressure in the Eagle Ford shale which negatively impacts well performance in Atascosa/Live Oak Counties, Texas.

Introduction

Previous studies of sedimentary rocks provide first order controls on fracture distribution and intensity (geologic structure, stress regime and mechanical rock properties, etc.). This is further defined by three factors: (1) proximity to the large scale structural components (2) the thickness of stratigraphic units and (3) the nature of interfaces between beds and bed thickness (Stearns and Friedman, 1972; Twiss and Moore, 1992; Ferrill and Morris, 2008; etc.) (Figure 1). Changes in fracture density can influence the charge, seal and productivity of any hydrocarbon reservoir and their identification and prediction are important in field development, even in unconventional reservoirs. When rock layers are subjected to tectonic stress, they bend, break, or do both. In its simplest form, a fault is a planar break or failure surface. However, field observations have shown these to be complex zones of fractures with varying amounts of offset. Because of these relationships, increased fracture density is often associated with antiforms, synforms and faults and these structures have been used to infer areas of increased fracturing from seismic data.

Method

In the absence of full azimuth 3D seismic data to identify fracture azimuth and fracture density, both surface based (curvature, dip, dip azimuth) methods and volume based (coherency, similarity, etc.) techniques can aid in the