Delineating Fractures Using Seismic Attributes

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Fractures can enhance permeability in reservoirs and hence impact the productivity and recovery efficiency in those areas. Fold and fault geometries, stratal architecture and large-scale depositional elements (e.g. channels, incised valley-fill and turbidite fan complexes) are often difficult to see clearly on vertical and horizontal slices through the seismic reflection data. Seismic attributes help us in characterizing stratigraphic features that may comprise reservoirs, and form an integral part of most interpretation projects completed today. Coherence, curvature and relative acoustic impedance are some important seismic attributes that are used for such analysis. However, for extracting accurate information from seismic attributes, the input seismic data needs to be conditioned optimally. This includes noise removal, using robust dip-steering options and superior algorithms for computation of seismic attributes.

Curvature attributes in particular exhibit detailed patterns for fracture networks that can be correlated with image log and production data to ascertain their authenticity. One way to do this correlation is to manually pick the lineaments seen on the curvature displays for a localized area around the borehole, and then transform these lineaments into rose diagrams to compare with similar rose diagrams obtained from image logs. Favorable comparison of these rose diagrams lends confidence in the interpretation of fractures. Another way is to generate automated 3D rose diagrams from seismic attributes and correlate them with other lineaments seen on the coherence attribute.

3D volume rendering is one form of visualization that involves opacity control to view the features of interest 'inside' the 3D volume. A judicious choice of opacity applied to edge-sensitive attribute sub-volumes such as curvature or coherence co-rendered with the seismic amplitude volume can both accelerate and lend confidence to the interpretation of complex structure and stratigraphy. Volume visualization of stratigraphic features is a great aid in 3D seismic interpretation and can be greatly aided by adopting cross-plotting of seismic discontinuity attributes in the interpretation workflow as we will demonstrate in this presentation.