Seismic Attribute Methodologies and their Application in Deciphering the Subsurface Geology

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Summary

Seismic attributes represent information derived from seismic data, applied to the interpretation of geologic structure, stratigraphy, and rock/pore fluid properties. There are various attributes aimed at characterizing lithology, discontinuities and facies patterns in the subsurface. The following attributes and their applications are discussed.

Coherence analysis of seismic data are used to recognize distinct features such as minor fault patterns, buried deltas, river channels, reefs and dewatering features. These features appear on coherence data volumes without interpretation bias.

Curvature attributes are computed on time surfaces as well as volumetric measures, with the latter proving more useful. They exhibit level of fault/fracture detail than the coherence attribute. Fault/fracture lineaments as interpreted on curvature displays can be calibrated with the available well control first manually picking of these lineaments for a localized area around a borehole. These lineaments are transformed into rose diagrams to compare with rose diagrams obtained from image logs and lends confidence to the interpretation of fractures.

Crossplotting of attributes is used for graphically visualizing relationships between different variables. For example, the crossplotting of P-reflectivity vs. S-reflectivity and fluid stacks in X, Y and Z axes can show a gas anomaly.

Automated pattern recognition of attributes combines other attributes which are used to identify relevant geologic features. For example, when a zone of interest is defined, one such application would be that the interpreter classify the seismic traces to define a set of waveforms that extract the variation of waveform patterns in the dataset. This could exhibit the facies patterns at the level of the reservoir.

Neural network attribute analysis is a multi-attribute process which uses the available log data and a suite of relevant input attributes to determine diagnostic attributes that are otherwise difficult to determine from seismic data. Examples are gamma ray, and density which are useful for characterizing subsurface reservoirs.