Application of Instantaneous Quality Factor (Q) Attribute in the Characterization of the Austin Chalk and Eagle Ford Shale, Maverick Basin, South Texas

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Abstract

Although the relationship between rock physical properties and the quality factor (Q) attribute has been recognized for several decades, the exploration community has not taken advantage of this attribute in reservoir characterization. Despite the fact that Q is a very powerful tool for detection of hydrocarbons and can help in the identification of brittle zones within unconventional resource plays, it has been featured less in hydrocarbon exploration than other seismic attributes such as reflection strength (amplitude envelope). This paper intends to demonstrate the importance of Q by presenting results of the application of instantaneous Q in the characterization of the Austin Chalk and Eagle Ford Shale within the Maverick Basin in South Texas. The method entails the computation of Q volume from 3D seismic data and then calibrates output with wireline logs. Wireline logs employed in this exercise include porosity, resistivity (deep induction), log-calculated total organic carbon (TOC), and water saturation logs to identify hydrocarbon sweet spots within the Austin Chalk and Eagle Ford Shale.

The linear relationship obtained by crossplotting Q traces versus log properties at well locations has enabled, in conjunction with other seismic attributes, hydrocarbon sweet-spot prediction within the Eagle Ford Shale and Austin Chalk. Results show that Q increases as acoustic impedance increases (i.e., increasing velocity), suggesting that Q can be used to identify high-velocity rocks such as brittle carbonate zones within shale intervals. In addition, the linear relationship between Q and TOC shows that Q increases as TOC increases, suggesting that the Eagle Ford Shale is a unique type of shale in which TOC increases with increasing carbonate (calcite) content. Similar results show that resistivity increases with increasing carbonate, suggesting that hydrocarbons are contained within carbonate-rich zones. However, relationships between Q and porosity and water saturation show that Q decreases as these log properties increase. These relationships are not confined to the Eagle Ford or Austin Chalk. The same types of relationships are observed in the Georgetown Formation, which is overlain by the Del Rio Formation below the Eagle Ford Shale. The conclusion based on the foregoing is that Q is a powerful tool that can be employed in hydrocarbon exploration in any geologic setting.