Multi-Source Data Integration: Eagle Ford Shale Sweet Spot Mapping (Part 1)

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Abstract

Chemostratigraphy employs major and trace elemental data to understand geochemical variability within sedimentary sequences. Major elements are used to calculate the brittle mineral fraction while redox-sensitive trace elements are used as paleodepositional proxies to recognize where organic carbon-rich intervals occur as a result of organic matter deposition and preservation. A comprehensive review has shown the geochemical dataset in this study has the ability to identify paleoredox facies changes (oxic to anoxic bottom-water conditions), and proxies for volume of clay (VClay) in terms of carbonate-rich and clay-prone facies. This dataset was used to elucidate vertical and lateral paleoredox conditions along with carbonate-rich and clay-prone facies variability within the organic-rich Upper Cretaceous Eagle Ford Shale and how that variability can affect well performance. In this study, we employ the use of major and redox-sensitive trace elements as effective proxies for distinguishing and mapping facies changes, which in turn are indicative of better performing or poorer performing regions within the Eagle Ford.

The geochemical dataset was further integrated with a geomechanical dataset. Relationships were developed to estimate the major and trace element responses from geomechanical properties using multi-attribute transforms, neural network analysis, and principle component analysis. 3D models of specific geomechanical properties derived via pre-stack seismic inversion were used to extrapolate predicted elemental data away from wells into 3D volumes of elemental data. This estimation of the geochemical response away from the wellbore using 3D surface seismic inversion products improves the lateral resolution and predictive capabilities of geochemical analysis, thus enhancing the utility of elemental data in identifying the most prospective regions in the Eagle Ford. Total Organic Carbon (TOC) and brittleness (VClay) of the Eagle Ford are two key performance drivers in Pioneer's 'sweet spot' acreage of DeWitt and Karnes counties. Well look backs in these counties have consistently shown that TOC and VClay can be correlated to well performance. Paleoredox conditions (TOC) and brittleness from major and trace element analysis and the extension of these geochemical data into 3D volumes of elemental data provide another tool to evaluate variability as well as high-grading intervals.