Geochemical Characterization of Immature Lower Eagle Ford Shale in Drill Cores from Southwest and Central Texas

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ABSTRACT

The U.S. Geological Survey has conducted drilling projects in the Upper Cretaceous strata of southwest and central Texas to facilitate interdisciplinary research into the stratigraphic, geochemical, mineralogical, and geophysical properties of the Eagle Ford Shale. Three drill cores were collected in McLennan (Gulf Coast #1, GC–1), Dallas (GC–2), and Kinney (GC–3) counties, Texas. The initial focus has been on the lower Eagle Ford (LEF) due to its known importance as a self-sourced, continuous oil and gas play and its role in charging reservoir rocks in other regional petroleum systems. Baseline geochemical and mineralogical studies have been conducted for all three cored wells to guide targeted investigations into the biostratigraphy, biomarker and stable-isotope geochemistry, and the interpretation of geophysical logs. These initial analyses included infrared spectroscopy, major and trace metal content, X–ray diffraction mineralogy, total organic carbon (TOC) content, and programmed pyrolysis on samples taken every two feet between the contacts with the overlying Austin Chalk and underlying Buda Limestone. Trace metal indicators were used to differentiate the upper and lower Eagle Ford intervals. Vertical fluctuations in trace metals, calcite content, TOC, and programmed pyrolysis parameters (e.g., hydrogen index, HI) were more extreme in the GC–1 and GC–3 cores than in the GC–2, which had lower maximum and average values related to organic matter content and quality. Calcite was the dominant mineral in the LEF in all three cores (40–80 wt. %), and clay mineral content was higher in the cores from north of the San Marcos arch. Tmax values for the LEF were consistently lower in all three cores than is generally observed for immature, type II/marine kerogen (~410°C vs. 425 to 435°C), indicating a more thermally reactive kerogen, possibly due to high organic sulfur content.

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