Comparison of Geochemical Properties and Mineralogical Data from Core and Cuttings Samples

Justin E. Birdwell[1], Jason A. Flaum[1], and Stanley T. Paxton[1]

[1]U.S. Geological Survey

Abstract

Evaluation of mudstone properties is an important step in characterization and assessment of source rocks and other petroleum system studies. Generally, cuttings material is more likely to be available than core, and though cuttings are usually collected at relatively low resolution (10's of feet), they can still provide useful analytical results, although some information on variability at finer scales is lost. However, the degree to which well cuttings represent the variations in different mudstone properties or show differences between stratigraphic packages is not often evaluated. During drilling of a shallow (178 to 650 feet) borehole through the Cenomanian-Turonian in the Texas outcrop belt near Dallas using an air hammer drilling system, care was taken to collect representative cuttings every 10 feet through roughly 450 feet of strata. Samples were also collected roughly every two feet from a core drilled approximately 20 feet from where the cuttings were obtained. The studied interval focuses on the informal upper and lower parts of the Eagle Ford Shale. In an initial survey of core properties, samples were taken every two feet for evaluation. Total organic carbon (TOC) content, programmed pyrolysis parameters, major and trace elements concentrations, and X-ray diffraction mineralogy were determined on both the core samples and aliquots of the cuttings. A rough comparison of the average values from the core samples corresponding to intervals for which cuttings were collected showed reasonable agreement. Bulk organic parameters, as well as major and trace elements in the averaged core intervals and cuttings were generally well correlated (R^2 ~0.6–0.9), but mineral phase concentrations showed lower correlation coefficients (R^2 ~0.4). Further evaluation compared samples sorted into stratigraphic packages identified in the core. A combination of lithologic descriptions, focusing on bedding thickness and continuity, sedimentary structure, and dominant component grains, as well as analytical results, particularly bulk organic geochemistry and trace element concentrations, were used to identify three dominant depositional facies in the core. Starting at the base of the studied interval, the facies include argillaceous deltaic (Facies 1), argillaceous prodeltaic (Facies 2), and calcareous/organic-rich offshore/hemipelagic (Facies 3) mudstones. Core and cuttings samples were assigned to a facies and average concentrations of organic, elemental, and mineralogical parameters were compared. Excellent agreement was observed for most parameters ($R^2 \geq 0.9$), though differences in mineralogy between core and cuttings indicate greater variability at smaller scales than is evident in the bulk organic and elemental data. The results show that although cuttings provide geochemical information at lower stratigraphic resolution than can be obtained with core samples, they can provide reliable information when core material is not available.

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