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Organic Matter and Porosity Distribution of the Eagle Ford Formation

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Mudrocks compose approximately two-thirds of crustal sedimentary rocks. Conditions of low oxygenation, slow depositional rates, and increased nutrient supply associated with oceanic anoxic events (OAE's) lead to accumulations of vast amounts of hydrocarbons in mudrocks. Hydrocarbon accumulation-mechanisms are poorly understood, however, mainly because of the difficulty in observing the micron-to-nanometer-scale petrofabric.

This study focuses on characterizing mineralogic and organic components of samples near the limits of SEM detection in order to further understanding of relationships between porosity, hydrocarbon maturation, and diagenesis. Samples from four cores across a range of thermal maturity in the Late Cretaceous Eagle Ford Formation are examined. Utilizing back scatter (BSE) and secondary electron (SE) in both field free and immersion modes (TLD), along with X-ray mapping (EDS), allows for components to be imaged topographically and compositionally from a micron to a nanometer scale.

Preliminary observations are that: samples appear to be dominated by detrital clay (clay minerals, with some clay-sized micas, feldspars, and quartz), organic matter, and authigenic carbonates, with relatively abundant globigerinid forams and some coccolith fragments. Two distinct types of organic matter have been observed: (1) Larger (~2-50 microns in length), particulate material which forms a rigid framework is interpreted as detrital kerogen, and (2) smaller (~500 nanometers-2 microns in length, can fill intraparticle pores up to 20 microns in diameter), interstitial organics that pervade much of the interparticle and intraparticle porosity are interpreted as (likely) bituminite and a product of maturation of detrital kerogen. Both organic types host nanometer scale pores with a variety of morphologies.

Both primary and secondary intraparticle, as well as interparticle pores are observed. Dissolution, potentially associated with organic acids produced by kerogen degradation, is observed in many of the carbonate components. Primary fossil hosted intraparticle porosity often contains authigenic carbonate and sulfide (pyrite) mineral growth. Interparticle pores are observed between clay platelets, circumcrystalline pores, and pores between both detrital grains and authigenic crystals.

Hypotheses include, but are not limited to: (1) organic hosted porosity may display a correlation with thermal maturity and/or TOC (as discussed in Milliken et al. (in press, AAPG Bulletin)), and (2) as discussed in Bernard et al. (2012, International Journal of Coal Geology) intramineral nanopores may be resultant from organic acids generated by thermal degradation of kerogen.

Keywords: Eagle Ford, Organic matter, Porosity, Mudrocks, Bitumen, Kerogen