Initial Petrographic Observations for Reservoir Characterization of the Tuscaloosa Marine Shale, Southern Mississippi, USA

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ABSTRACT

The U.S. Geological Survey recently completed an assessment of undiscovered, technically recoverable unconventional petroleum resources in the Upper Cretaceous marine shale of the Tuscaloosa Group in the U.S. Gulf Coast. Data collected for the assessment included analyses of permeability and porosity, mineralogy, thermal maturity, and geochemistry. To date there are few reports that use optical petrography or scanning electron microscopy (SEM) to characterize the Tuscaloosa marine shale (TMS) in southern Mississippi. Here we describe new optical and SEM data to interpret TMS reservoir characteristics, building on our previous data sets.

Porosity ranges ~4–10%; permeability is < 0.003 md; semi-quantitative X-ray diffraction (XRD) analyses indicate quartz, illite, and kaolinite are the primary minerals; TOC ranges ~0.1–3.7 weight percent; measured %VRo ranges ~0.6–1.0; and kerogen is mixed Type II–III, oil-gas-prone. Optical microscopy (polarized transmitted light; reflected light; blue light excitation) of polished thin sections shows that all samples contain euhedral and framboidal pyrite and foraminifera tests. Some tests were infilled and replaced by pyrite. This pyritization occurred early in the diagenetic history of the sediments and spectacularly preserved foraminifera test structures. Two samples at different depths within the same well display pyrite "rimming" under reflected light, where the outer section of pyrite in contact with the matrix is less reflective than the inner section. Planned SEM energy-dispersive X-ray spectroscopy (EDS) analyses may possibly determine compositional differences between inner and outer sections of these pyrites. Many samples also contain shell fragments and glauconite; some contain apatite; radiolarian debris is rare. Sparry calcite with lamellar twinning replaces biogenic shell fragments. Inertinite, vitrinite, and alginite are also present in many samples. SEM–EDS analyses confirmed the presence of apatite, carbonate, mica, quartz, pyrite, and feldspar, which are also present

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in XRD results. Additional work is necessary to characterize depositional environment and history.