

Assessing Unconventional Resource Potential of Lower Cretaceous Carbonates in the South Florida Basin, USA

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ABSTRACT

The South Florida Basin incorporates southernmost Florida, including the Keys and eastern Gulf of Mexico. It is a relatively simple SW dipping structural basin with predominantly Cretaceous sediments. In this study, the two main unconventional exploration targets are the L. Sunniland Fm. and Pumpkin Bay Fm. The Sunniland is composed of mixed organic-rich/lean limestone and dolomites; shales are scarce to absent. Most conventional oil is found in carbonate reservoirs in the U. Sunniland and from fractured limestone in the LSRZ. The Pumpkin Bay is reported to contain organic-rich, argillaceous carbonates that are the likely source for oil in the mid/upper Pumpkin Bay and the brown dolomite zone of the overlying Lehigh Acres Fm. An integrated investigation was conducted to assess hydrocarbon prospectivity of these L. Cretaceous source rocks, with a focus on the Collier Hogan 20-3 well. The L. Sunniland represents a moderate geochemical risk for shale oil development. It is a good source with zones of elevated organic richness (1.29 wt.% TOC) and dominantly oil-prone Type II-S kerogen. However, thermal maturity parameters indicate it is in the early oil window for Type II-S kerogen (0.56% Ro) and key risk ratios are below minimum thresholds for shale oil. Hydrocarbon yield calculations suggest the interval generated moderate amounts of oil and a majority of this has been retained within the source rocks. Core extracts and production oils are sulfur-rich (3.8 wt.%) and heavy (API 19.1°); characteristics associated with low maturity oil. Biomarker analyses clearly correlate produced oil with in-situ generation from the L. Sunniland. Although whole oil fingerprints showed abundant light hydrocarbons, bulk fractional analysis show elevated polar+asph content (35%), suggesting the in-situ oils may be relatively immobile. The Pumpkin Bay was not extensively sampled, however, geochemical data suggest poor source potential (0.23 wt.% TOC) and a high risk for shale oil. Organic matter is composed of inert Type IV and gas-prone Type III kerogen. Thermal maturity parameters place the Pumpkin Bay in peak oil window (0.68% Ro) for Type II-S kerogen, but only incipient generation for a Type III kerogen. This amount of conversion would be sufficient to generate only trace amounts of hydrocarbons. Core extract biomarkers contain features associated with lean source rocks deposited under oxidizing conditions and clearly distinguish Pumpkin Bay from L. Sunniland samples.