POTENTIAL FOR LACUSTRINE-EMBAYMENT DEPOSITS WITHIN MARINE UNCONVENTIONAL WOODFORD SHALE IN CENTRAL AND SOUTH OKLAHOMA

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ABSTRACT

Research over the past few years has focused on the stratigraphy and sedimentology of the Devonian-Lower Mississippian Woodford Shale. The Woodford is not only a good mid-continent (U.S.A.) oil and gas producer, but also a good analog for other 'siliceous' unconventional resource shales, particularly if they are underlain by carbonates. The studies have emphasized detailed mapping and stratigraphic characterization of the Woodford, but have also provided a foundation for extending into relating stratigraphy to geophysical, geochemical (organic and inorganic) and geomechanical characterization. It is generally assumed by shale researchers that the Woodford (and most analog resource shales) is wholly of marine origin. RockEval analyses usually indicate Type II kerogen, however, occasionally a Type I kerogen is detected. Other unconventional resource shales show a similar pattern, but these anomalies are often shrugged off as analytical error.

3D seismic surveys reveal an unconformity surface on top of underlying carbonate rocks, with considerable karst topography and > 100m of vertical relief. From this, a geological model has been developed which claims that during lowstand of sea level, karst topography forms an irregular surface which can provide discontinuous catchment areas for ponding of hypersaline/lacustrine water masses, forming restricted water circulation and establishing conditions for the deposition and preservation of Type I kerogen. 3D seismic surveys inverted to provide TOC maps have shown discontinuous, "podlike" areas of anomalously high TOC and thickness in the lower Woodford. This is in contrast to common thinking that organic-rich strata are deposited from marine waters in a blanket fashion.

This proposed research tests the hypothesis that within dominantly marine unconventional resource shales there will be some horizons that are of hypersaline/lacustrine origin, and which will contain Type I, oil-prone intervals. The same features could apply to other resource shales underlain by carbonates; these shales will also be tested. Of practical importance is the greater chance for improved oil generation in areas that have been condemned for exploration because of gross-interval screening techniques.

This research is the first to evaluate the presence of periodic restricted, hypersaline/lacustrine deposits within an unconventional resource marine shale. The products of this research will determine if rocks of a marine environment under very restricted conditions can additionally support the accumulation of hypersaline/lacustrine organic matter. If so, in large interval analysis of unconventional shales where the marine rock intervals are in high thermal maturity the liquid hydrocarbons are cracked to gas, but in similar maturity level for the lacustrine deposits, the sourced oil will be preserved or more resistant to thermal cracking, thus providing previously unidentified exploration and prospectivity targets in unconventional marine shales.

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