**3-D Petroleum Systems Modeling Applied to Unconventional Shale Gas Play: Prediction of Sweet Spots Based on Areal and Depth Distribution of Sorption Capacity in Shale Gas**

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Three dimensional and two dimensional Petroleum Systems Modeling is a widespread methodology in the oil industry and a standard component of most basin evaluation studies. Relatively rare is the application of these petroleum systems modeling to assess sweet spots in unconventional shale gas plays.

According to Jarvie (2007), shale-gas resource plays can be distinguished by gas type and by system characteristics. Gas is stored in shale source rocks in two principal ways: as gas adsorbed to and absorbed in the organic matrix, and as free gas in pore spaces and in fractures created either by organic matter decomposition or other diagenetic or tectonic processes.

Organic richness, kerogen type, and thermal maturity impact the sorptive capacity of organic matter. Sorption capacity also affects expulsion efficiency.

In this paper, by means of a case history, the variability of the gas adsorption and saturation thresholds as a function of temperature, maturity, and kinetic scheme is investigated through space and time by means of a 3D numerical simulation of hydrocarbon generation and expulsion from a marine shale source rock. This study was done using the Petromod 3-D modeling program, which incorporates the Pepper hydrocarbon retention/expulsion methodology.

The main results of this evaluation are the following:

1.Temperature: in the low heat flow scenario, the marine shale source rock reached temperatures above 320 0F (160 0C) where liquid hydrocarbons are cracked into gas 1,000 ft. deeper than in the high heat flow scenario, 15,500 ft. versus 14,500 ft.;

2.Maturity Transformation Ratio: in the low heat flow scenario, the marine shale source rock reached at present day 90% TR 1,000 ft. deeper than in the high heat flow scenario, 14,000 ft. versus 13,000 ft.;

3.Maximum gas sorption: in the low heat flow scenario, maximum gas sorption occurred between 13,500 ft. and 15,500 ft. In the high heat flow scenario, maximum gas sorption occurred between 12,500 and 14,500 ft.

4.Maximum gas sorption: using different kinetic scheme for Type II organic matter, maximum gas sorption occurred between 13,000 ft. and 17,000 ft. in the low heat flow scenario. In the high heat flow scenario, maximum gas sorption occurred between 12,000 and 15,500 ft.

Based on these results it was possible to select sweet spot locations to be leased for this project, consequently minimizing the lease and exploration costs.