Formation and Characterization of Turbidites: Mathematical Models, Scaling Analysis and Simulation

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Abstract

Turbiditic oil reservoirs in the deep of Gulf of Mexico are the likely major source of new petroleum reserves in the United States. Because these reservoirs are located in challenging and expensive environments to produce oil, it is crucial for the reservoir to be well characterized for successful exploration and exploitation.

I will discuss recent efforts to characterize turbidites based on geophysical models of their formation. First, mathematical models of the dynamics of dilute and concentrated turbidity currents will be described that predict deposition as a function of initial volume of the suspension or its flow rate, the suspension load and the basal topography. Predictions from these models of the extent and thickness of deposits from turbidity currents will be shown to compare very well to laboratory experiments and field data, verifying the validity of the geophysical flow models. Examples of how these models can predict the porosity and permeability distributions throughout a deposit at centimeter length-scales will also be presented.

Of course, initial conditions are necessary in order to use the depositional models to predict extent, thickness and porosity and permeability distributions. It will be shown how these initial conditions may be determined by parameter estimation and inversion techniques using available seismic and cores ensuring that the well-data are honored. Examples of the application of this methodology to generate and characterize a deposit from core data will be shown for synthetic and field data.