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Water-Flooding Incremental Oil Recovery Study in Middle Miocene to Paleocene Reservoirs, Deep-Water Gulf of Mexico

Bin Liu, Richard Dessenberger,SPE, Kenneth McMillen, SPE, Joseph Lach, SPE, Knowledge Reservoir LLC, Mohan Kelkar, SPE, University of Tulsa

Introduction

Many deep-water Gulf of Mexico (GoM) discoveries of the past five years are in water depths greater than 4,000 feet and in older Tertiary reservoirs of middle Miocene to Paleocene age (yellow dots in Figure 1)[1]. Structural styles of these lower slope fields include compressional anticlines, turtle structures and sub-salt three-way dip closures against salt faces. Some of these reservoirs are highly compartmentalized by faulting. In this setting, rock compaction may be less important as a production drive mechanism, and aquifer support (possibly augmented by water flooding) assumes more significance. Porosity and permeability decrease is related to greater burial depth and compaction as well as temperature-related cementation. Older middle Miocene to Paleocene reservoirs in GoM are characterized by the following:

- Reservoirs are often at greater subsea depths: 20,000 to 30,000 ft
- Reservoirs often have high pressure (>15,000 psi) and temperature (>180°F)
- Turbidite deposition was in coalescing basin floor fans, i.e. sheet sands
- Seismic imaging is poor due to allochthonous over-hanging salt
- Reservoirs are consolidated, resulting in lower rock compressibility
- Increased diagenesis in sands with volcaniclastic components results in cementation and reduced compressibility
- Paleocene reservoirs often have poorer porosity (<15%) and permeability (<30 mD)
- Primary recovery factors are expected to be low due to the reservoir properties

3. Uncertainty Parameters

A total of fourteen static and dynamic parameters are used in this stochastic study. The geologic uncertainty parameters incorporated into the static models include: structural dip, faulting, facies, aquifer size, and reservoir parameters (initial reservoir pressure, absolute permeability and heterogeneity). Dynamic uncertainty parameters include: fluid properties, water injection variables (timing and injection rates), and relative permeability variables (residual oil saturation and endpoints). All the uncertainty parameters are treated as independent variables as shown in Table 2. For each parameter, high and low extreme values and medium value are determined according to the extensive study on lower Tertiary reservoirs in GoM.

Parameter		Real Values		
		Low	Medium	High
F12	Rock Comp (10E-6 1/Psi)	1	3	10

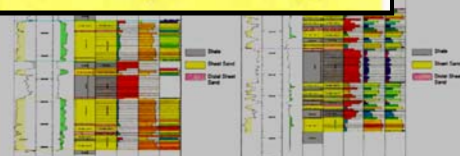

Figure 3. Facies/NtG distribution of the thin bedded sand massive sand in the model