AAPG International Conference: October 24-27, 2004; Cancun, Mexico

How Analyzing Variations in Gas-Oil Ratio Led to Improved Understanding of a Giant Deepwater Reservoir

*B James[1], **L. D. Meckel, III**[2], D. McKinney[3], G Ugueto[3], B. Dindoruk[4], J. W. Kendrick[4], and S. Hara[3]. (1) Deimos Exploration Team, SEPCo, 701 Poydras St, One Shell Square, New Orleans, LA 70139, bruce.james@shell.com, (2) Mars Basin Nearfield Exploration, SEPCo, 701 Poydras St, One Shell Square, New Orleans, LA 70139, (3) SEPCo, (4) Shell*

PVT data from undersaturated black oil columns in separate structural accumulations in the giant “Yellow” reservoir at the Mars, Princess, and Ursa fields (northern Gulf of Mexico) suggest that each field has a unique gas-oil ratio gradient (delta GOR/delta Z). Flow behavior of wells can be difficult to model in the presence of such gradients. However, we demonstrate that the magnitudes of the gradients are a function of the amount of isotopically light, or biogenic, gas present in each accumulation, and that the gradients are linear due to convective gravitational overturning. Both conclusions aid in predicting well performance.

Additional complications are present at Ursa, where GOR contours do not conform to structural contours (possibly indicating local disequilibrium conditions) and a highly undersaturated, dew-point fluid occurs just slightly up-dip of a highly undersaturated black oil. Such unusual conditions can cause significant difficulties in trying to interpret reservoir connectivity, especially if wells are widely spaced, as is common in the deepwater.

However, production-related pressure declines indicate that the three fields are in hydraulic communication across tens of kilometers. Connectivity is further demonstrated by remarkably similar fluid maturity data in the three accumulations, and by an oil accumulation immediately SE of Ursa, which has a GOR gradient similar to Mars, over ten kilometers away. Finally, the fluid properties from updip producing wells at Ursa have changed dramatically over production time scales, supporting the idea of a GOR-stratified oil column and the production of oil from progressively deeper portions of the reservoir.