AAPG Annual Meeting
March 10-13, 2002
Houston, Texas

Scott (Liangmiao) Ye[1], Michael J. King[1], Dirk Seifert[2] (1) BP, Houston, TX (2) Phillips Petroleum Co, Bartlesville, OK

Lessons learned while modeling the Gravity Drainage Water Flood Interaction (GDWFI) area of the Prudhoe Bay Field, North Slope of Alaska

The studied GDWFI area of the Prudhoe Bay Field, North Slope of Alaska, is dominated by fluvial sandstones and conglomerates interbedded with non-permeable shales of variable continuity and high-permeability open-framework conglomerates (OFC). A 3D geocelluar model was constructed based on the data from 90 wells, 26 horizons, and 37 faults.

A multi-scale modeling approach was taken to capture the key reservoir heterogeneities. Structure and faults were derived from the seismic interpretation, combined with mapping techniques. Major shales (of floodplain/marsh deposits) were mapped deterministically.

For intervals between major shales, five facies, including conglomerate, clean sand, fine sand, discontinuous floodplain shale, and abandoned channel-fill shale, are modeled stochastically using object-based approaches. Each is conditioned to well data, volume proportions, orientations, and dimensional distributions obtained from the reservoir and outcrop analog studies. OFC and bar drape shale were modeled as subfacies, with OFC being constrained in the conglomerate and bar drape shale in the clean sand and fine sand. Facies-based porosity and permeability were modeled using pixel-based stochastic simulation, again conditioned to well data and their spatial variability. These models were then upscaled for GridGenr and VIP reservoir simulation.

Significant lessons are learned from this study, especially about 1) the benefits of combining coarse and fine scale modeling, 2) the benefits of combining deterministic and stochastic modeling approaches, 3) the appropriate level of detail of facies modeling and importance of capturing variation in the background facies, 4) the effective upscaling to GridGenr and VIP, 5) the effective data management and modeling workflow.