

## **Are Geologic / Reservoir / Completion Models Properly Constrained (are they working) in the Permian Basin?**

**Bill Fairhurst**

*Riverford Exploration, LLC*

### **Abstract**

Multiple resource horizons are being targeted in the Permian Basin. These include the Spraberry, Bone Spring (Spraberry time equivalent in the Delaware Basin) and Cline (upper Pennsylvanian). It also includes re-exploration and development of upper Permian targets on the Central Basin Platform, northern shelf, deeper basins, Woodford and others.

The Wolfberry in the Midland Basin and WolfBone in the Delaware Basin have been the main focus over the last several years with growing interest and attention focused on the other reservoirs as knowledge, implementation and execution have enhanced economic results and applied to other reservoirs. As an example, the WolfBone development in the southern Delaware Basin is a sample of combining geologic, reservoir and completion results to guide economic development of the play and is reviewed.

The Wolfcamp is an ideal heterogenetic resource consisting of quartz, carbonate and kerogen. Exploration and field development will be successful over a large area. However, the geologic and economic sweet spot is generally found in the deeper basin floors. In this setting quartz and kerogen accumulated in the quiet deep-basin interrupted by episodic deposition of shelf to basin floor carbonate debris flows that settled basin ward of de-acceleration boundary between the slope and basin floor. These depositional processes resulted in compositional and grain-size heterogeneities and accumulation of the thick organic-rich, technically and economically exploitable targets.

During maturation large volumes of oil were sealed in place (108 MMBOIP per Section). Upslope, up dip or in more shaley facies, these conditions do not exist and are outside the economic sweet spot. Units thin and become more shaley retarding geochemical maturation. Some units become more gas-prone and the mixture of coarser-grained shelf carbonates and sand-stones provided migration pathways breaching the closed system, limiting productivity and ultimate economic recoveries. In those environments generally deeper stratigraphic units are targeted. This play has been developed initially and continuing today with vertical wells co-mingling the oil-resource with conventional reservoirs. Interpretation of imaging logs has identified the primary fracture orientation and zones with conjugate fractures systems. Integration with production logs, chemical tracers, micro-seismic has optimized horizontal target identification and horizontal drilling has overtaken vertical well development.

Have we maximized and fully integrated drilling, geology, reservoir description, stimulation, production information and economic results? Are we working on the same scales and communicating observations providing feedback among disciplines? Some observations are provided.