Maturing Tight Reservoir Plays in the Permian: Why Geoscience Still Matters

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ABSTRACT

It has been 30 years since Mitchell Energy drilled their first horizontal well in the Barnett Shale, North Texas, eventually ramping up gas production there in the late 1990s. By 2018, the US had become the world's leading oil producer with the bulk of these oil volumes coming from horizontal wells in tight reservoir plays. With increased focus on profitability, cash flow, and environmental, social, and governance (ESG) compliance, identifying the areas of highest potential productivity, and their underlying subsurface controls, is essential. Estimating original resource in place and technically recoverable resource (TRR), and predicting future drilling locations, is challenging in tight oil/shale gas plays. This especially true in the more recently-developed Permian Basin for several reasons: (1) Multiple major reservoirs (Wolfcamp, Bone Spring, and Spraberry) are distributed across most of the Delaware and Midland subbasins with a variety of facies and reservoir properties; (2) Reservoirs are drilled with evolving vertical/lateral spacing patterns and wells are completed with highly-variable intensities; (3) Vertical wells provide core and petrophysical data, but production comes from the mostly unlogged completion intervals from some 30,000 horizontal wells; and (4) Major controls on well productivity differ from other US shale plays.

As a result of these challenges, basin-scale geocellular models, some exceeding 1 billion cells, are built in order to integrate and distribute key subsurface attributes and form the basis for pinpointing major controls on production variability. The ultimate goal is to forecast the locations and scale of future production across each play based on estimated profitability. We estimate that Permian Basin–wide, TRR potential of the Wolfcamp A and B formations and the 3rd Bone Spring Sand, is approximately 75 BBO and 360 TCF of gas. Using the Wolfcamp A drilling location inventory as an example, we divide the total well inventory into productivity bins, indexed by actual and predicted first-year production per 1000 ft of horizontal

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length. Not surprisingly, the relatively small top tier bin has the highest percentage of inventory drilled and completed. As the well inventory is found generally to be normally-distributed with respect to first-year productivity, the prevailing number of drilled wells—and the bulk of the remaining drilling opportunities—occur in the middle tiers.