Scale-Dependent Performance Drivers in the Wolfcamp Shale of the Midland Basin, West Texas

Donny Loughry[1], Paul Clarke[1], and Gervasio Barzola[1]

[1]Pioneer Natural Resources

Abstract

The term "sweet spot" is often used in resource plays to describe areas of favorable well performance. Sweet spots can be identified in multiple ways, from a simple map that highlights wells with the highest estimated ultimate recoveries (EUR), to areas of top-tier reservoir quality/deliverability, to more complex metrics that describe economic performance and value (i.e. the ratio of constituent produced fluids with respect to commodity prices).

In the Midland Basin of west Texas, multiple stacked Wolfcampian-age successions have proven productive from horizontal, hydraulically stimulated wellbores. These organic-rich shale sequences vary both vertically and laterally in terms of their overall thickness, depth, mineralogy, hydrocarbon storage, fluid saturations, thermal maturity, and pore-pressure gradients. Understanding performance in wells targeting these successions is best achieved by a detailed knowledge of completion effectiveness, lateral length, and geologic considerations in combination. Importantly, geologic drivers may operate independently and at differing resolutions. For example, changes in the level of thermal maturity vary over a long wavelength (basin scale), whereas changes in clay content vary over relatively short distances (1 to 3 miles) due to changes in sediment input and depositional processes. Because shale performance drivers are scale-dependent, only when the reservoir is characterized at the sub-regional scale is it possible to identify lower amplitude performance drivers. Mapping of pore pressure gradients and initial reservoir pressures, collected from nearly 2000 vertical wells with multi-stage completions, reveals that pore pressure (correlation to normalized well performance, $R2 = 0.7$) is a highly predictable regional-scale performance driver. Additionally, "working pressure," the amount of pressure in excess of the bubble point pressure within the reservoir, is further used to refine and high-grade acreage. This paper demonstrates the importance of identifying geologic performance drivers at multiple spatial scales and provides technical context for the emerging Wolfcamp Shale "sweet-spot" within the Midland Basin. With a high quality dataset of over 250 producing wells, production trends for the Wolfcamp Shale are delineated, and patterns and relations interpreted in order to more accurately predict well performance and high-grade development drilling.