Generation of a Regional 3-D Pore Pressure Model for the Wolfcamp Formation in the Delaware Basin, New Mexico and Texas

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ABSTRACT

Pore pressure in the Wolfcamp (lower Permain age) has proven to be one of the key drivers in the success of drilling and completing wells in the Delaware Basin petroleum system. Prediction and identification of pressure regimes, as well as abrupt pressure changes, has been identified as a major driver for play development and safety in the oil and gas industry. The combination of discrete pressure measurements and petrophysical rock properties have yielded additional insights to the petroleum system within the Wolfcamp across the Delaware Basin in southeastern New Mexico and Texas.

This paper describes the workflow used for generating a three-dimensional (3D) regional pore pressure model of the Wolfcamp formation. The 3D model was built using a database of over 23,700 mud weight recordings, Drill Stem Test (DST) ISIP readings and Diagnostic Fracture Injection Test (DFIT) pressures from over 4,000 vertical wells. Additionally, the Bower's method of computing pore pressure from acoustic logs (Bowers, 1995) was used on over 100 wells to add vertical heterogeneity throughout the basin. This data was checked and then geostatistically distributed throughout an earth model. The 3D model was validated by cross-checking it against actual drilling reports and mud weights from horizontal wells.

Using this model, predictions for abnormally pressured zones can be extracted along the planned wellbore, thus helping to avoid drilling and completion challenges. The model also demonstrates a distinct lithologic change preceding a large pressure spike, indicating a regionally identifiable sealing stratigraphy. This may help to explain the differences in pressure regimes within the Wolfcamp formation across the Delaware Basin.