Geologic Modeling of Wolfcamp and Bone Spring Formations, Delaware Basin

Brian Casey[1], Robin Dommisse[2], David Carr[3], Scott Hamlin[2], Amin Gherabati[2], Lily Horne[2], Inessa Yurchenko[2]

[1]Casey PetGeo Consulting LLC; [2]University of Texas at Austin; [3]University of Texas

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Abstract

We have been constructing geologic models for the Delaware Basin Pennsylvanian-Wolfcampian-Leonardian interval for several years. The present model has increased the wells with interpreted litho-facies to almost 2000 over this interval, and completed the petrophysical analysis of about 900 wells. The resulting geologic model showcases our understanding of facies distributions, geometries and orientations, and the associated distributions of petrophysical and hydrocarbon fluid properties. Model results should be useful as an independent analysis with regional context; these results can potentially be used to guide much more detailed analysis of individual lease-hold positions. We have, in addition, been attempting to more precisely define basin boundaries of the Delaware Basin and Central Basin Platform. The “gap” between currently recognized basin boundaries and these more recently drawn boundaries may influence thoughts about geographical limits of production. The modeling process is very straight-forward. We have built upon our prior research by gathering our most recent facies and petrophysical analyses, mapped out individual lithofacies units, and used these geometric and orientation results to guide sequential indicator simulation. Porosity and water saturation values have been added from petrophysical analysis, along with pressure gradient, gas-oil-ratio, and formation volume factor analyses to provide hydrocarbon in place results for the entire Delaware Basin. In overview, siliciclastic deposits seem to have been dominated northern and southern sources during the Upper Wolfcampian. Carbonate clastic deposits during that same period appear to be shed from all sides of the basin, but less so from a southerly source. The Wolfcamp A and B are definitely more silciclastic-starved

than the overlying Bone Spring. In the modeling of litho-facies geometries and orientations, we recommend using individually mapped facies to help set geometries and orientations used in variogram analysis. We are still working on the hydrocarbon fluid properties, using a basin analysis approach to determine the impact of thermal maturation versus hydrocarbon migration to explain the westward increase in gas-oil-ratio.