Ultrarefined Geological and Reservoir Simulation Models of a Mannville Coal Reservoir for Optimized Methane Production

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Abstract

The Western Canadian Sedimentary Basin hosts large volumes of deep coal seams that are potential targets for methane production. The most prominent ones, which are currently under commercial gas production, are the Horse Shoe Canyon, Belly River Group, and Mannville coals. The Mannville coals can be further subdivided into the Upper Mannville and Lower Mannville units and have the highest gas concentration but they are deep and have highly complex geology. In our work, we have focused on building a detailed geological model and reservoir simulation model for the Upper Mannville coal to simulate coal bed methane production. In total, log, core, special core, adsorption, and well test data from 26 wells were used to build the geological model. A combination of the gamma ray and bulk density logs was used to define four facies (sandstone, shale, sand, and coal) and associated porosity-permeability transforms, and relative permeability curves, and capillary pressure curves for each rock type. The results of the analysis demonstrate that the coal exists as laterally discontinuous seams interbedded with very fine sandstone and shale layers, which exhibit very low porosity with huge variability of permeability over relatively short distances when compared to overlying coal strata. The resulting ultrarefined reservoir model has been matched to coal bed methane production data to tune the rock type properties. In future work, the model will be used to examine microbial stimulation methods for enhancing gas production rates.