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Flow Simulation Model of the Wall Creek Member in the Frontier Formation: Powder River Basin, WY

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ABSTRACT

The Frontier formation in the Powder River Basin has been re-discovered for oil and gas potential with the development of long horizontal wells and multi-stage hydraulic fracturing. Over the last decade, the Wall Creek member of the Frontier formation has proven to be a successful hydrocarbon-producing target, yet a full understanding of this complex structure has not been achieved. The complexity of the Wall Creek depositional environment has challenged geologists to understand the vertical and lateral heterogeneity of the play; furthermore, the fluid and rock properties have uncertainty and are not well defined. To develop better recovery strategies, an integrated reservoir model using geologic, petrologic, petrophysical, and geophysical data is created to evaluate different scenarios of how the play may occur in the reservoir. The work started by using a representative horizontal well to create a single-well flow simulation model including properties of the reservoir such as porosity, permeability, relative permeability, capillary pressure, and water saturation. Using the three offset well logs, a 32 feet interval was selected to represent the net pay zone of the Wall Creek member. The porosity was estimated by averaging the neutron and density porosities, and permeability was established by applying a correlation of porosity and permeability found from the core data. By matching a PVT report from the well, a black oil model was created to represent the reservoir fluid. The production history was matched by modifying the initial fluid saturations and the rock physics parameters such as relative permeability and capillary pressure. As a result, representative fluid and rock physics models were obtained for the reservoir. Sensitivity analysis was conducted to observe the effect of changing reservoir properties and hydraulic fracture properties on production. Well spacing and fracture spacing studies were also performed. Overall, this work allows for a better understanding of what is happening in this reservoir and provides a range of possible production rates for a number of reservoir properties in the field. One of the most important outcomes from this model is the determination of reasonable fluid and rock physics parameters, which can be used in geologic models that capture the complex small-scale structural heterogeneity observed in outcrops. For the future work, this model will be combined with an outcrop study of Wall Creek heterogeneity to determine the appropriate method to upscale the complex, heterogeneous models to the well scale models. Different geologic scenarios will be evaluated to help determine the best strategy for field development. The Frontier formation in the Powder River Basin has been re-discovered for oil and gas potential with the development of long horizontal wells and multi-stage hydraulic fracturing. Over the last decade, the Wall Creek member of the Frontier formation has proven to be a successful hydrocarbon-producing target, yet a full understanding of this complex structure has not been achieved. The complexity of the Wall Creek depositional environment has challenged geologists to understand the vertical and lateral heterogeneity of the play; furthermore, the fluid and rock properties have uncertainty and are not well defined. To develop better recovery strategies, an integrated reservoir model using geologic, petrologic, petrophysical, and geophysical data is created to evaluate different scenarios of how the play may occur in the reservoir. The work started by using a representative horizontal well to create a single-well flow simulation model including properties of the reservoir such as porosity, permeability, relative permeability, capillary pressure, and water saturation. Using the three offset well logs, a 32 feet interval was selected to represent the net pay zone of the

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