New Approaches to the Prediction of Long-term Shale Gas Production and Economics based on Early Production data in Barnett Reservoir
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Introduction
The prediction of long-term shale gas production has been an attractive topic in recent years. An efficient estimation of long-term shale gas production from early production data is an advantage for not only reservoir management but also field development planning. In this study, the relationship between the early production data (peak production rate, 3-, 6-, 9-, and 12-month cumulative gas productions) and shale gas performance in terms of cumulative gas production (CGP) and net present value (NPV) for shale gas at 10, 15, 20, 25, and 30 years is investigated through numerical simulation and production data analysis.

Simulation and Results
A reservoir model was generated with input data including reservoir properties and hydraulic fracturing design parameters are based on the basis of available data in the Barnett shale. A total 485 simulation production datasets were generated to develop shale gas performance prediction models. A third-order polynomial model and a first-order response surface methodology model (RSM) were employed to describe the relationship between the early production data and the performance of a shale gas well. Key parameters of the prediction model were identified through ANOVA results. The developed prediction models show high correlation between the simulated early production data and the performance of a shale gas well (R² > 0.98). The developed prediction models were then validated for its applicability in the field condition using 250 Barnett field production datasets which have more than 10 years of production history. The decline curve analysis was applied for extrapolating the field production data to 30 years long term production. The validation results show that the prediction models based on the third-order polynomial yield has a good agreement between the predicted and measured values of shale gas performance (R² > 0.90). Whereas, the prediction models based on RSM yield overestimation of CGP and underestimation of NPV. Therefore, the prediction models based on third-order polynomial are selected for the prediction of shale gas performance in Barnett reservoir.

Conclusion
Prediction models were developed for efficiently and reliably predicting long-term shale gas production and economics based on early production data. The proposed models are consistently applied for young wells with short production histories and lack of reservoir and hydraulic fracturing data. Additionally, the results of this study are useful for field development planning since the long-term shale gas performance are predicted using only 1-year production data.

Keywords: shale gas, production data analysis, performance prediction, cumulative gas production, net present value

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