Data Integration for Engineered Completion Design in the Marcellus Shale

Liwei Li[1], Payam Kavousi[1], Bingjian Li[2], BJ Carney[3], Timothy Carr[1]
[1]West Virginia University; [2]Blackriver Geoscience LLC; [3]Northeast Natural Energy LLC

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Abstract

Maximizing stimulated reservoir volume is one of the primary hydraulic fracturing concerns for economic production from horizontal shale gas or oil well. We developed a workflow to evaluate the optimal placement of multiple clusters for each stage to enhance production per lateral. The proposed engineered completion design aims to address the challenges from Marcellus subsurface geologic complexities including extensive natural fractures, variations in geomechanical properties, and reservoir characterizations. LWD acoustic borehole image data is interpreted and used to characterize natural fractures and sub-seismic faults with proper output including fracture type and intensities for each lateral. The clusters, as proposed in our study, attempt to avoid high fracture density zones for potential increased perforation efficiency. The reason is because significant amounts of fracturing fluids and proppants can be diverted into these reactivated pathways during injections. Furthermore, the clusters are designed in evenly distributed laterals with “similar rock” properties. The key parameters in identifying these regions is the minimum horizontal stress, which was derived from near-bit accelerations and upscaled every 5 feet (1.5m). In addition, drilling parameters including rotation per minute (RPM), rate of penetration (ROP), weight on bit, and mechanical specific energy are coupled to the grading for optimizing cluster spacing and stage length. The proposed engineered completion design takes advantage of integrating high-resolution drilling, acoustic well logging, and the near-bit induced vibration data recorded from Marcellus Shale Energy and Environment Laboratory wells in Monongalia County, West Virginia. As a result, several 12,000-foot (3600m) horizontal laterals are optimized for cluster perforations. We are building machine learning approaches for automatic

cluster picking that improves the recognition of fractures and quality of the geomechanical interpretation. The goal is to better design successful engineered completion design.

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