Field Laboratory for Emerging Stacked Unconventional Plays (ESUP) in Central Appalachia

Highlights from Research Performance Progress Report 6

Reporting Period: July 1, 2019 – September 30, 2019

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PROJECT GOALS

The Field Laboratory for Emerging Stacked Unconventional Plays (ESUP) in Central Appalachia project will investigate and characterize the resource potential for multi-play production of emerging unconventional reservoirs in Central Appalachia. The project is designed to improve characterization of the multiple emerging unconventional pay zones that exist in the established Nora Gas Field through the drilling and coring of a deep vertical stratigraphic test well up to 15,000 feet. Additionally, the ESUP Field Laboratory Team will explore and quantify the benefit of novel non-aqueous well completion strategies in this region. The project team will monitor the drilling of at least one multi-stage lateral well in the emerging (and technologically accessible) Lower Huron Shale for completion using non-aqueous fracturing techniques such as CO2 and advanced proppant technologies. Laboratory analysis, reservoir simulation, and monitoring observations will be integrated. An assessment will be made of the multi-play resource potential and a recommended strategy advanced for prudent development that considers regional environmental and socioeconomic impacts.

ACCOMPLISHMENTS

Work Related to Project Tasks

Task 1 – Project Management and Planning

In the previous quarter, Virginia Tech and EnerVest updated the AFE (Authorization for Expenditure) for the deep well and presented those to the U.S. Department of Energy's National Energy Technology Laboratory (DOE/NETL) in face-to-face meeting on June 12, 2019, in Washington, DC. The AFE was based on drilling rates from the nearest Rogersville well drilled in Kentucky where drilling rate data was available. The research team presented 3 options to reduce the cost-overruns while not significantly reducing the scope of the project. On July 18, 2019, Virginia Tech requested a No-Cost Time Extension (NCTE) to extend Phase I of the ESUP project until October 31, 2019, that will allow for the time needed to negotiate either additional federal funding

or changes to the scope of the project to stay within budget. The NCTE was approved by DOE/NETL. On August 8, 2019, DOE/NETL let the project team know that they will accept modification to the award to stay within current budget and abandon the second objective. Virginia Tech and EnerVest agreed to this and a revised Statement of Project Objectives (SOPO) and corresponding budgets and cost-share letters were approved by all parties. Moving into Budget Period 2 was approved with an October 1, 2019, start date.

Task 6.1 – Initial Characterization and Design

During this quarter, researchers at Virginia Tech worked on geologic characterization, core testing and reservoir modeling of the Lower Huron shale in order to inform completion strategies. The research team utilized a Support Vector Machine (SVM) algorithm to classify shale as high clay content or low clay content using conventional well logs. This work will be presented in the 2019 SEG 3rd International Workshop on Mathematical Geophysics: Traditional vs. Learning. Data from horizontal wells will be included into the SVM model to retrain the model and examine the reliability of the prediction. Core Analysis included acquiring core (stored at Virginia Department of Mines, Minerals and Energy in Charlottesville, VA) through all portions of the Lower Huron shale. This core is being analyzed in conjunction with the core donated by EnerVest in order to inform completion strategies for the Lower Huron shale.

In this period, we continued to conduct the fracture conductivity experiments. The intention of this group of experiments is to investigate the mixture effect of different sizes of proppant on the fracture conductivity. In the future research, we will investigate the effect of embedment for the fracture conductivity.

The reservoir simulation group continued work on three different tasks to characterize the Lower Huron shale and evaluate completion strategies. This included the following: (1) building a field scale reservoir simulator for current Lower Huron horizontal wells in Virginia; (2) building a fracture model by applying different fracturing fluids and proppants; and (3) calculation molecular diffusion coefficients for methane, N2 and CO2 under nano-pore confinement.