

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

## Highlights from Research Performance Progress Report 7

Reporting Period: October 1, 2019 – December 31, 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 CO<sub>2</sub> 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

EnerVest, the U.S. Department of Energy's National Energy Technology Laboratory (DOE/NETL), and Virginia Tech held bi-weekly conference calls and the Virginia Tech research team held weekly technical meetings to discuss progress on updating the AFE (authorization for expenditure), core analysis, geologic characterization, reservoir modeling, and plans for field work. Late in the previous quarter (September 2019), Virginia Tech and DOE/NETL came to agreement on changing the scope of the project to focus on the deep characterization well and a modification was received by Virginia Tech. On October 1, 2019, the project moved into Budget Period 2. During the last two weeks of September and into October, Virginia Tech and EnerVest discussed

timing with vendors on their ability to drill the well late Fall 2019. On October 21, 2019, Virginia Tech let DOE/NETL know that the research team felt it was in the best interest of the project to not spud the well until mid to late March 2020. This decision was made for two reasons. The first being that the operator with the rigs (Patterson) did not have rig availability until December 20th. The second reason was, based on that start date, EnerVest felt there was a significant risk to cost overruns if there was inclement weather where the project would have to pay rig time and other vendors' down time waiting on services. While these discussions were ongoing, Virginia Tech's Procurement Department continued to negotiate contracts with vendors and finalized multiple contracts including that for building the well site and grading and graveling the access road.

Virginia Tech and EnerVest presented an update on the project to US DOE/NETL including an revised timeline and schedule to drill the deep characterization well via a web meeting on December 16, 2019.

#### Task 7.0 – Geological Characterization of the ESUP Field Laboratory Site

This task will include drilling a vertical characterization well approximately 15,000 feet in depth and all activities including initial characterization of the geology and potential pay zones based on data and core samples from the well. Virginia Tech reached a contract agreement with JWT to level and gravel the well site which they completed this past quarter (pictured below). Work continued on the Well Drilling, Logging and Coring Report and plans were presented to DOE/NETL on December 16, 2019. The well pad will be allowed to settle over the winter and the drill rig will be moved onto location in late Quarter 1 or early Quarter 2 of 2020.



#### Task 8.0 – Geologic and Reservoir Characterization

This task will include activities to design, construct, and implement the ESUP Field Laboratory, including the drilling and completion of 1-2 lateral wells in the Lower Huron Shale and the installation of

monitoring infrastructure. The activities during this period are in the following areas: core analysis, reservoir modeling and simulation, and geologic characterization.

Core from the Virginia Department of Mines, Minerals and Energy in Charlottesville, Virginia, is being analyzed in conjunction with the core donated by EnerVest in order to inform completion strategies for the Lower Huron shale. Analyses of permeability, adsorption, and fracture conductivity are currently being completed.

The research team continued work on the Support Vector Machine (SVM) algorithm to classify shale to develop multiple classification tasks involving clay, QFM and TOC. Work next quarter will include eliminating bad quality points and retraining the model to evaluate performance. In addition, we will reset the criteria boundary for practical purposes and seek improvement by that boundary and reconsider the performance evaluation using recall and precision.

### **Dissemination of Results and Outreach Activities**

During the past quarter, graduate students presented their work at three different conferences and submitted two papers to journals (one has been accepted and another is under review).

- Fengshuang Du presented a paper titled “Estimating Diffusion Coefficients of Shale Oil, Gas, and Condensate with Nano-Confinement Effect” at SPE Eastern Regional Meeting in Charleston, WV on 10/16/2019.
- Xinyu Tan presented a poster titled “Microseismic forward modeling for a novel non-aqueous fracturing field test” at the 2019 SEG 3rd International Workshop on Mathematical Geophysics: Traditional vs Learning in Beijing, China on 11/7/2019.
- Yu Hu presented a poster titled “Applying an Ensemble Support Vector Machine (SVM) to Lithofacies Prediction in the Lower Huron Shale” the 2019 SEG 3rd International Workshop on Mathematical Geophysics: Traditional vs Learning in Beijing, China on 11/7/2019.
- Xinyu Tan presented a poster titled “Micrometer-scale Experimental Characterization of the Lower Huron Shale in the Central Appalachian Basin” at the AGU Fall Meeting in San Francisco on 12/12/2019.