Evaluating systematics of lithofacies and petroleum production in the Mississippi Lime Play (MLP)--Integration of Core, Cuttings, and Wireline logs

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SUBSURFACE APPLICATION: Mississippian plays in the Midcontinent
TIMING: Upon funding; Phased program: 1) evaluate data availability and industry participation; 2) collect data, analysis and assess; 3) acquire additional field data and lab analyses; 4) integrate and correlation information, establish relationships, and build quantitative predictive models.
FUNDING: Proposal in process to fund

Purpose
Proposed research would: 1) identify and characterize key productive lithofacies in the context of their depositional diagenetic, and structural setting; 2) characterize pore system from petrographic analysis; 3) integrate petrophysical (routine and SCAI) and geomechanical measurements from core and samples from equivalent surface exposures; 4) combine rock information with well logs and seismic properties such as impedance, Vs/Vp; 5) compare results with well performance, production, completion techniques, and specific reservoir conditions; and 6) establish systematic relationships of oil and gas production.

Project Description
The Mississippi Lime Play (MLP) produces oil and gas from a range of lithofacies that were deposited along a structurally active ramp that borders incipient Arkoma and Anadarko Basins in southern Kansas and northern Oklahoma. The ramp is modified by structurally-derived salients and embayments that control the trajectory of a complex stratal progradation and subsequent diagenesis. Moreover, internal high frequency depositional sequences and subaerial exposure along the inner ramp areas has led to complex lithofacies succession and geometries making characterization of lithology and pore types imperative in deciphering targeted reservoirs in the MLP.

The resolution of the lithofacies and their correlation along the ramp is hampered by older well log suites that serve as the dominant basis for subsurface control for the MLP. Where available quantitative analysis of modern well logs with core and sample based lithofacies information is needed to: 1) classify lithology, pore types, and fluid content (saturations, capillarity), 2) depositional trajectories (stratal geometries) in order to develop better reliable predictive geomodels, and 3) importantly, to establish key properties of pores and fluids including hydrocarbon saturation, permeability and capillary pressure to evaluate producibility of lithofacies that are encountered, refine completion methods, and estimate reserves.

Hydrocarbon bearing lithofacies as currently understood (Watney) range from 1) highly porous and moderately permeable tripolitic bioclastic spiculitic grainstones developed along the inner ramp typified as low resistivity pay; 2) variably porous and permeable reworked chert breccias in inner ramp locations residing along the basal Pennsylvanian unconformity,
particularly near larger uplifts and subcrops; 3) siliceous spiculitic and bioclastic cherty dolomites in mid ramp locations with mid level porosity and permeability; 4) moderate to very porous and permeable dolospiculites and dolosilites in lower ramp, deeper water setting; 5) tight organic-bearing argillaceous siliceous dolosilites with varying organic matter and thermal maturity suggesting possible self sourcing deposited in lower ramp; and 6) local structural deformation, fracturing, and 7) hydrothermal overprinting affecting any of the above.

The inventory would be developed with close collaboration with industry participant(s) to share 1) core and cuttings including routine, SCAL, and geomechanical measurements; 2) well and local seismic data to provide context for sampling; and 3) well test, completion, and performance data to compare and develop correlations. One or more professor, staff, and students would participate including petroleum engineering, geology, and geological survey.

**Deliverables**

The project would integrate geologic, engineering, and geophysical data from key lithofacies that comprise the MLP reservoirs ranging from high quality to marginal reservoirs with the goal of creating a systematic classification of the reservoirs based on measurable properties that are correlated to their performance as oil and gas reservoirs. The results would be closely related to completion techniques and optimal designs to maximize well performance.