

## **Integrated Reservoir Characterization for Hydrocarbon Exploration & Production, CO<sub>2</sub> Sequestration, and Critical Mineral Resource Exploration & Production**

**Calvin C. Reppe<sup>1</sup> and Ivana M. Stevanovic<sup>1</sup>**

<sup>1</sup>RC Allan

<sup>2</sup>PhD

### **Abstract**

Reservoir characterization is a multi-disciplinary analysis, that is essential to reduce the geologic and economic risks for any geologic play and basin in North America. The integrated reservoir characterization techniques are utilized in the evaluation, analysis, and identification of the specific geologic reservoir characteristics for any geologic play. Reservoir characteristics for each geologic play whether for hydrocarbons, CO<sub>2</sub> sequestration, or critical minerals may be similar in their approach, but are unique to each reservoir (play). The reservoir characterization analysis includes: 1) well log (raster and LAS), mud log, core, drill stem tests (DSTs), petrophysics, and sequence stratigraphy; 2) borehole temperature, API, gas oil ratios (GORs); 3) source rock and rock mechanics which includes organic and inorganic chemistry; and 4) seismic, fracture identification, structural, and 3D reservoir modeling. These techniques are then incorporated into an integrated reservoir characterization model and applied into the drilling, completion, and reservoir engineering. These techniques do not need to be costly, especially if already available geologic data is utilized and paired with a precisely modeled study.

A reservoir characterization was conducted for the Cretaceous Frontier/Turner sandstone reservoir in the Powder River Basin. The cost for the analysis (chemostratigraphy, proppant embedment, XRD, and organic and inorganic chemistry) was \$75,000. This reservoir characterization was presented in 2014 at the Niobrara Conference. The same analyses were presented at this conference by a competitor for a cost of \$500,000. Another reservoir characterization was conducted to reevaluate a failed exploration “resource play” in the Delaware Basin. The operator failed to identify the ‘key’ reservoir(s) that were identified by the historic DSTs. The operator drilled and completed 5 marginal wells in a shale interval that did not represent a reservoir. The operator walked away from a >\$250 million investment and sold for <\$1 million.

These integrated reservoir characterization techniques will significantly improve the economics of the geologic plays. A TEAM approach and working relationship that has the same goals will result in the identification and high grading of “sweet spots” for greater producibility and achieving the project economic benchmarks, i.e., rates of return (ROR), return on investment (ROI), net present value (NPV), and multiple revenue streams for the hydrocarbon, CO<sub>2</sub> sequestration, and critical minerals projects.