Integrating Outcrop and Subsurface Data to Evaluate Data-Poor Shale Plays: the Canol Formation, Northwest Territories, Canada

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Introduction

Studying outcrop sections is a cost effective way to obtain datasets comparable to those that may be obtained from long, continuous drill cores. These studies have the added benefit of enabling larger-scale lateral observations. In particular, critical observations can be made about lithology, depositional environments, stacking patterns and sequence stratigraphic interpretations that can be extrapolated to wireline log and seismic data for the subsurface play analysis.

The caveat of extrapolating outcrop data to the subsurface is that uplifted and exhumed outcrops may exhibit the effects of a retrograde pressure and temperature history. Mechanical and chemical surface weathering processes can dramatically alter rock properties. This means we need to be cautious when extrapolating aspects of the plays such as maturity, porosity and mechanical properties of the outcrops to the subsurface. However, within these constraints, outcrop data can add value in understanding play commodity type, reservoir quality and mechanical properties as well as general lithology, depositional setting and sequence stratigraphic interpretation.

Theory and/or Method

In this study we integrate outcrop observations and measurements made in the Mackenzie Mountains, Northwest Territories, Canada into our understanding of relatively data-poor Devonian-aged shale plays in the adjacent Peel and Mackenzie Valley Basins. Several vertical sections were measured and correlated to adjacent subsurface well and seismic control to understand the distribution of lithofacies within a sequence stratigraphic framework. This allows us to deduce depositional settings and understand the distribution of favorable mudstone reservoir types in the area. Spectral Gamma Ray profiles measured in outcrops were used to precisely correlate surfaces from outcrop to well logs in the basins. Geochemical and pore architecture measurements made from outcrop samples were utilized to propagate rock properties to wireline log data and inform the distribution of critical play elements in the basin areas.

Examples

Figures and an extended abstract will be provided is accepted and wnternal corporate release is received.

Conclusions

We found that the basin architecture and the presence of both siliciclastic and carbonate depositional systems provide first-order controls on the distribution of favorable shale reservoirs. The learnings from the outcrop work can be used to better understand other age-equivalent shale plays in North America that lack high-quality outcrops.

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Selected References

Pyle, L.J., and Jones, A.L., (Eds). 2009. Regional Geoscience Studies and Petroleum Potential, Peel Plateau and Plain, Northwest Territories and Yukon; Northwest Territories Geoscience Office and Yukon Geological Survey, NWT Open File 2009-02 and YGS Open File 2009-25.

Gal, L.P. and Pyle, L.J. 2011. Geological Field Guide for Cambrian to Cretaceous Strata in northern Mackenzie Plain, Franklin Mountains, and northern Mackenzie Mountains, Northwest Territories; Northwest Territories Geoscience Office, NWT Open File 2011-06

Hayes, B.J.R., 2011 Regional Characterization of Shale Gas and Shale Oil Potential, Northwest Territories; NWT Geosciences Office NWT Open File 2011-08.