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Gas Shale Potential of the Shaftesbury Formation, Northeastern British Columbia

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Summary

The Mid-Cretaceous Shaftesbury Formation in northeastern British Columbia is evaluated as a potential gas shale resource, in a study area centred around the town of Tumbler Ridge (Fig. 1). From the wells investigated, the Shaftesbury Formation is up to 540 m thick with an average thickness of 400 m across the study area. Mud logs reveal higher gas kicks at the Basal Fish Scales (BFS) and the first 10-20 m of shale at the base of the formation (BOU – Basal Organic-rich Unit). This study has focussed on mapping trends within these two units. TOC content ranges between 0.5 and 8.01 wt% with an average of 2.8%. Maturity values range between the T_{max} values of 400°C and 477°C which increases to the south and southwest of the study area. Total porosity varies can be as low as 4% and as high as 20% in the shallower wells and within the BFS. Methane sorption capacity, calculated to the reservoir pressure, is between 0.14 and 5.49 cm^3/g and example is shown in Figure 2. The highest methane capacities are associated with the characteristics of higher porosity, higher reservoir pressure (greater depth) and greater maturity. Cross plots of all data revealed no significant trends between methane capacity and maturity, TOC content and mineralogy. However, there are some trends within single wells. Two regional cross-sections along depositional strike and dip directions (Figure 1) show spatial and stratigraphic trends for the entire Shaftesbury Formation.

Introduction

With many exploration teams focusing on the Besa River shales and Montney Formation, the Shaftesbury Formation is being overlooked due to its younger geological age (Cretaceous) and assumption that it is too immature to produce thermogenic methane and diagenetically immature to be optimal for creating an economically-viable, stimulated reservoir volume. The Ohio shale, a potential analogue for the Shaftesbury shale, in the Appalachian Basin, eastern USA is an example of a shale that does not have high silica content like the Barnett Shale but is still a major producer of gas due to natural fracture networks. The Shaftesbury

shale has similar mineralogical characteristics as the Ohio shale (i.e. detrital silica) and natural fractures may play a part in assessing the reservoir. The main objective of this study is to obtain results to evaluate the potential of the Shaftesbury Formation as a viable gas shale resource.

Methodology

Samples were collected from recently drilled wells, from archived cuttings and cored samples collected from the Charlie Lake Core facility. Organic geochemistry and maturity data were obtained from Rock-Eval II fitted with a TOC module. XRD diffraction analysis with the use of the Reitveld program are utilised to determine the mineral composition of the shale. Methane sorption analyses were performed on shale sample milled to less than 250 µm. Methane sorption experiments were performed at the UBC using high pressure (< 9 MPa) volumetric sorption apparatus. Samples were run at reservoir temperature and reported at reservoir pressure (hydrostatically calculated). Total porosity was determined by mercury porosimetry and includes all pores greater than 3 nm. Porosity is only considered on a dried basis and is not effective porosity.

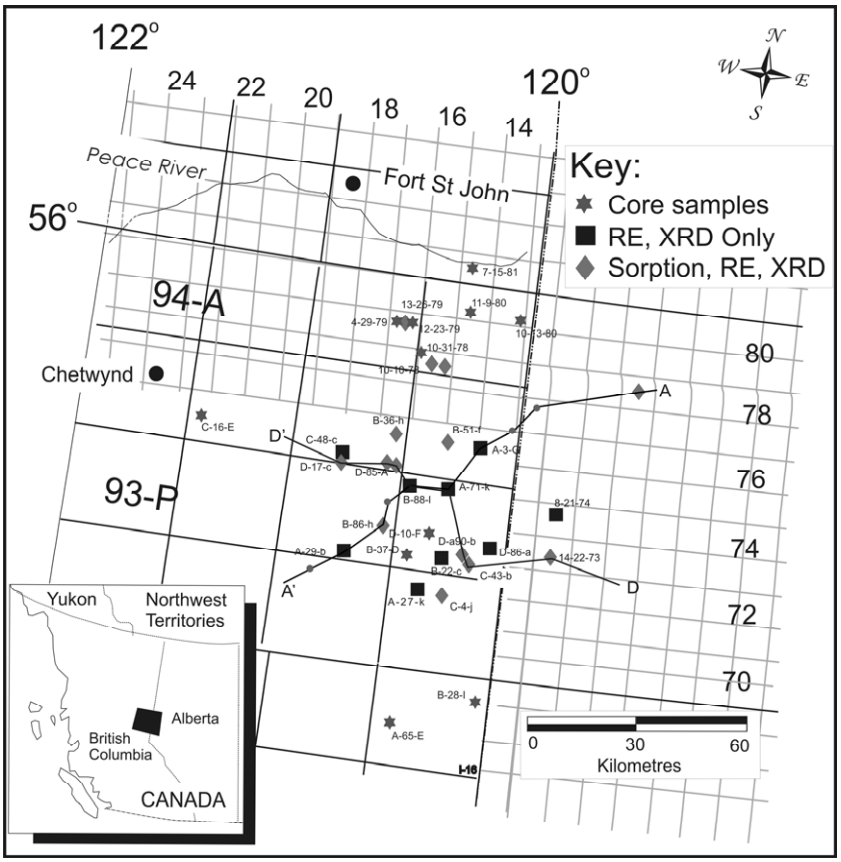

Figure 1: Cutbank study area within Northeastern British Columbia, highlighting the wells analysed within the study. Explanation of key: “RE” refers to Rock Eval analysis, “XRD” to mineralogical data and “Sorption” refers to high pressure methane sorption capacity analysis. Cored samples had all analyses performed.

Examples

An example of an isotherm from well # 4-19-78-10W6 at a depth of 945 m is shown in Figure 2. This figure has a fitted curve based on the Langmuir model and illustrates how the methane sorption capacity at reservoir pressure (9.35 MPa) is calculated.

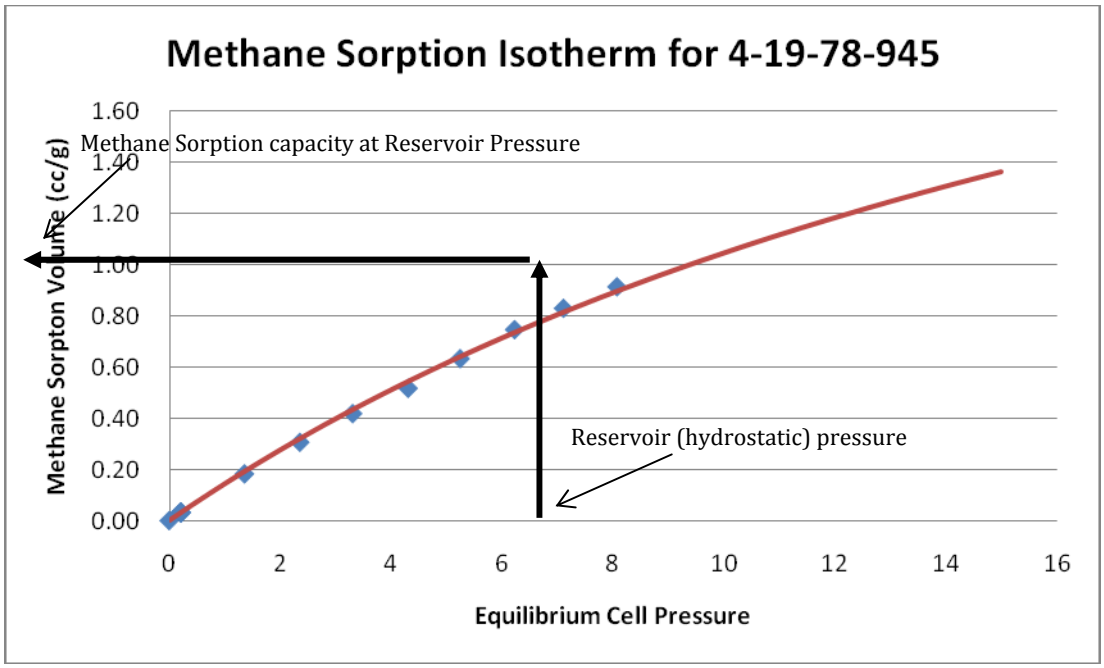

Figure 2: An example of the methane sorption isotherm for one sample from the Well # 4-19-78-10W6. The methane sorption capacity is 1.00 cc/g at reservoir pressure (assuming hydrostatic pressure).

Conclusions

With high gas contents found with higher porosity, methane sorption capacity and higher reservoir depths, the Shaftesbury formation has the greatest methane potential close to the deformation front, south and southwest of the study area. The high sorption capacity and high porosity of the Shaftesbury, together with large gas kicks within the mud logs illustrates the great potential of this shale that is overlooked by many exploration teams.

Acknowledgements

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