

Shale Gas in Canada's North? Preliminary Investigation of Horn River Group in Mackenzie Plain, Northwest Territories

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Introduction

Mackenzie Plain is a petroleum producing and exploration area located in the central Mackenzie Valley of the Northwest Territories (Figure 1). In this region, proven and potential hydrocarbon resources occur within the Peel Trough, a broad structure occurring between the arc of the Canadian Cordillera (Mackenzie Mountains) and the eastern margin of the Keel Arch (Morrell et al., 1995; Figure 2). Mackenzie Plain boasts one of Canada's first and largest oilfields at the town of Norman Wells. Delineation of this famous discovery has proven 235 million barrels ($37.5 \times 10^6 \text{ m}^3$; Morrell et al., 1995) of recoverable oil that is pooled in a Middle Devonian (Kee Scarp Member) reef structure.

Mackenzie Plain is relatively well explored with peak activity occurring in the late 1960s and 1970s. During this time, industry focused its efforts on the pursuit of a second Norman Wells oilfield. This exploration phase resulted in the drilling of 76 exploration wells, the majority of which occur in a narrow corridor near the town of Norman Wells. Beyond this immediate vicinity, exploration in the Mackenzie Plain region has been much sparser. At present, the only production in the Mackenzie Plain occurs from the Norman Wells oilfield; however, recent discoveries along the eastern mountain front of the Mackenzie range (Summit Creek B-44, 2004; Stewart D-57, 2006) have renewed interest in the area.

The potential for additional hydrocarbon discoveries in Mackenzie Plain exists, particularly in Cambrian, Devonian, and Cretaceous strata. In order to advance the geoscience knowledge of key petroleum plays, a five-year (2009-2014) field- and subsurface-based study is being conducted by the Northwest Territories Geoscience Office. One goal of this investigation is to assess the unconventional potential of Middle to Upper Devonian Horn River Group strata.

The Horn River Group, Mackenzie Plain, Northwest Territories

In Mackenzie Plain, Middle to Upper Devonian Horn River Group comprises the Hare Indian, Ramparts, and Canol formations (Pugh, 1983). These strata are well known for their source rock potential and consist of interbedded organic-rich, siliceous, fine-grained siliciclastics and limestone. Horn River Group is equivalent to highly prolific gas-bearing strata in the Horn River Basin of northeast British Columbia. With estimated gas-in-place volumes of 500 Tcf ($1.42 \times 10^{13} \text{ m}^3$), the Horn River Basin is the largest gas accumulation ever discovered in Canada, and the third largest in North America (EIA, 2010). Additional gas resources may be present in the Mackenzie Plain (Hannigan et al., 2009); however, the unconventional potential of Horn River Group strata remains unexplored.

Field Work and Preliminary Results

Field and subsurface studies in 2010 were conducted to evaluate the shale gas potential of Horn River Group strata. Field methods involved measurement and detailed sampling of four Horn River Group outcrop sections in the northern Mackenzie Mountains, and the collection of detailed spectral gamma-ray data by a hand-held scintillometer. Subsurface investigation involved describing and sampling (core chips and unwashed cuttings) several exploration wells in Mackenzie Plain. Samples were analyzed by vitrinite reflectance (VR), X-ray diffraction (XRD), induced coupled plasma (ICP), assay, and permeability/porosity methods.

This talk presents elemental, mineralogical, maturation, and rock fabric characteristics of Horn River Group strata in Mackenzie Plain. Comparison of these data with information from other prolific shale gas developments across North America will provide an initial evaluation of the potential for unconventional plays within the succession.

References

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Figure 1: Northwest Territories, Canada. The Mackenzie Plain petroleum producing and exploration region is highlighted in red (boundaries of Mackenzie Plain delineated in Mossop et al. 2004).

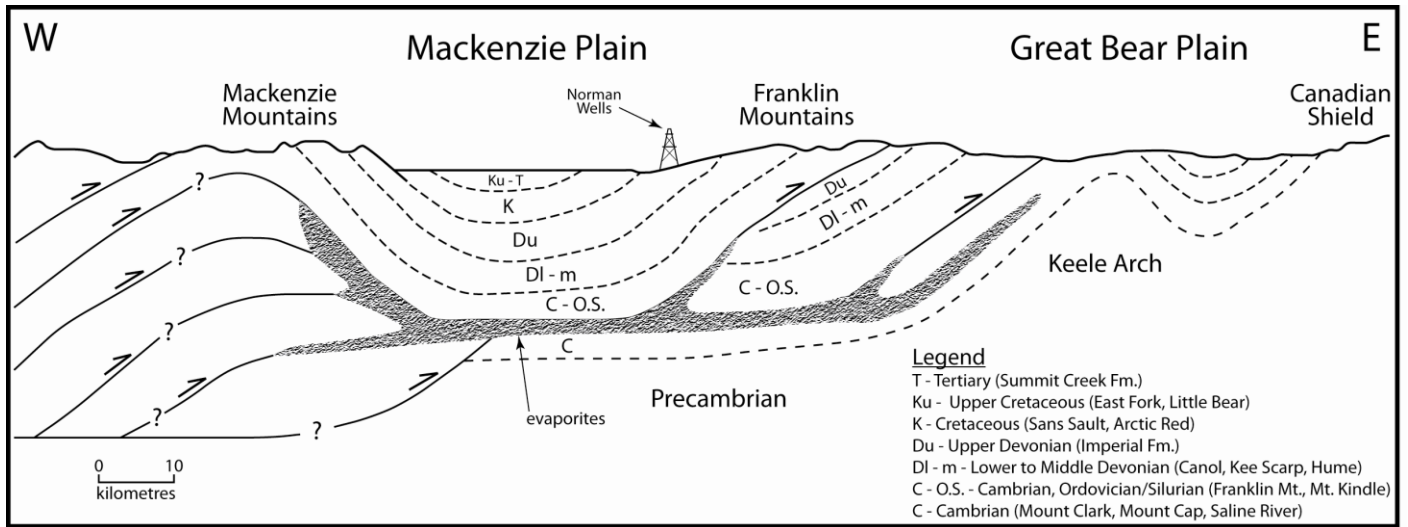


Figure 2: Structural depiction of the Mackenzie Plain (modified from Morrell et al. 1995).