

Geological Setting and Play Concepts for Cretaceous and Tertiary Age Coalbed Methane Opportunities in Western Canada

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ABSTRACT

Western Canada is blessed with abundant coal resources, located primarily in the Western Canada Sedimentary Basin that encompasses southeast and northwest British Columbia, Alberta and Saskatchewan; and in a number of restricted basins in British Columbia. Throughout most of the coal-bearing strata within these basins coal gas (CBM) has been determined to be present in varying quantities. At present, these gas resources are untapped, yet they could ultimately exceed Canada's conventional on shore gas resources by 2 to 3 times.

A review of the geological setting of these coal-bearing basins reveals that the coals can be categorized into four different coalbed methane play types. Each of these plays has unique geographical, geological, hydrological and engineering characteristics that influence the exploration and development strategy for specific CBM targets. The four play styles are:

1. Restricted Basins
2. Shallow Foreland Basin
3. Deep Foreland Basin
4. Foothills and Mountain Regions

There are a number of restricted basins in British Columbia that have demonstrated coalbed methane potential. Coals of the Nanaimo and Comox coalfields on Vancouver Island have a history of being gassy and a number of desorption tests have been completed validating the potential of several specific coal seams. Other basins, such as Hat Creek, Merritt, Bowron River, Telkwa and Bowser all contain coals of sufficient rank to have generated either thermogenic or biogenic coal gas. Individual coal seams are commonly laterally discontinuous and reside within a structurally complex geological framework. To date, limited

drilling access, distance from market and environmental or stakeholder issues have hindered any significant CBM exploration and development.

Shallow foreland basin prospects are defined as coal zones that lie at depths less than 750 m and lie within the relatively flat-lying stratigraphic interval underlying the plains region of Alberta, Saskatchewan and northeast British Columbia. The main coal-bearing formations are the Tertiary age Scollard Formation in western Alberta, the Edmonton and Belly River groups in central and southern Alberta and the Mannville Formation in eastern Alberta and western Saskatchewan. The main characteristics of this play type are the shallow depths of the coal sequences; lower rank and gas content of the coals and in general, a lack of structural complexity. Reservoir permeability and efficiency of drilling costs will control prospectivity of this play type

The deep foreland basin play type is characterized by coal of the Mannville Group at depths ranging from 750 m to more than 2000 m. The main coal-bearing unit is defined as the Mikwan or Medicine River zone, a laterally persistent horizon with gas contents ranging from 8 to 15 cc/g. To the east, the lateral equivalent of the Mannville Group coals tend to thin and have a lower rank with gas contents similar to those recorded in the younger Upper Cretaceous and Tertiary age coal measures. The Medicine River coal zone has been penetrated by a large number of oil and gas wells in Alberta and Saskatchewan and may be a candidate for re-completion technology. To date, no commercially viable CBM prospects have been developed within the deep foreland basin setting, primarily due to poor reservoir permeability and high drilling costs.

The foothills and mountain regions of Alberta and eastern British Columbia provide perhaps the greatest opportunity for CBM exploration targets based upon coal thicknesses and relative gas contents. In the Mist Mountain Formation in southeast British Columbia and southwestern Alberta up to 75 m of cumulative coal has been recorded and as measured gas contents are commonly greater than 15 cc/g. In the northern foothills region of Alberta and northeast British Columbia, coals of the Gates and Gething formations commonly have gas contents greater than 17 cc/g. The foothills and mountain regions are structurally complex and the potential CBM plays are defined by structural and geographical boundaries more so than coal distribution. Reservoir permeability may be a major encumbrance due to high horizontal stress regimes and optimal exploration targets may lie in areas where structural overprinting has led to enhanced permeability. Drilling costs tend to be high due to infrastructure and lithification of the rock units.

Table 1 summarizes the key geological parameters for each play type within the western Canada coal-bearing basins. Further CBM exploration and pilot project development is required to further quantify these parameters and enhance the number of CBM prospects that may be present.

Table 1

Parameter	Units	Restricted Basin	Shallow Foreland Basin	Deep Foreland Basin	Foothills and Mountains
Coal Seam Thickness	Metres	2-250*	5-15	2-11	2-15
Cumulative Coal Thickness	Metres	10-250*	5-25	5-20	15-75
Coal Quality (ash)	%	10-20	15-20	5-15	5-25
Coal Rank		High Volatile C to Anthracite	Sub-Bituminous C	High Volatile A Bituminous	High Volatile A to Semi-Anthracite
Gas Content	Cc/g (ASB)	7-12	2-4	8-15	8-20
Depth Range	Metres	200-1500	200-750	750>2000	200-1600
Permeability	mD	<1 to 5	1 to 10	<0.1 to 5	<1 to 10
Infrastructure		Generally poor	Established	Established	Poor
Water		Saline to Fresh	Generally Fresh	Saline	Generally Fresh
Stakeholder Issues		High	Moderate to Low	Moderate to Low	Moderate

* The 250m thickness of coal represents the Hat Creek coal basin and is unique to this single basin in Canada.