Comparison of the Coalbed Methane Potential of the Ardley Coals of Alberta with Producing Coals of the Fort Union Formation, Powder River Basin

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ABSTRACT

Vast resources of sub-bituminous coal occur in the Ardley coal zone of the Paskapoo Formation at depths down to about 700 m. These coals extend over much of south-central Alberta (60 000 km^2) and comprise a tremendous resource of thermal coal, methane and potentially a repository for acid and flue gases. The Ardely and Fort Union Formation (Tongue River Member) coals of the Powder River Basin are about the same age (Paleocene), have similar composition (vitrinite rich) and rank (mainly sub-bituminous) and sedimentology (alluvial plain). The Fort Union coals have an estimated 25 trillion cubic feet ($7 \cdot 10^{11} m^3$) of recoverable coalbed methane and the present daily production is 471 MMCF ($13.4 \cdot 10^6 m^3$). Currently there is no commercial production from the Ardley coals nor have economic gas reserves been assigned. The total methane resources in the Ardley coals are estimated to be between about 20 and 25 TCF (5 to $7 \cdot 10^{11} m^3$).

Less than 15 wells have reportedly tested the coalbed methane potential of the Ardley coals however exploration drill holes for both petroleum and thermal coal have established the distribution and thickness of the coals. In marked contrast, in the Powder River Basin, 9400 wells have been drilled to date specifically to test and/or produce coalbed methane.

In the Ardley coal zone there are up to 12 major coals seams up to 4 m thick and the total cumulative coal is in excess of 20 m. The Fort Union coals of the Powder River basin have a cumulative thickness of up to 100 m with up to 32 distinct seams up to 60 m thick. The little data that exists on the Ardley coals suggests gas contents are variable but values of 30 to 100 scf/ton (0.9 to 3.1 m^3/tonne) occur and the gas is dry with little or no associated carbon dioxide. Methane adsorption analyses indicate the gas capacity of the Ardley coals at reservoir pressures is up to 100 scf/ton (3.1 m^3/tonne). The capacity of the coal to carbon dioxide is about an order of magnitude greater than that to methane and the hydrogen sulphide capacity is about 50 times that of methane. The Ardley coals thus have potential as repositories of acid and flue gases. The gas content and capacity of the Fort Union coals averages about 50 scf/ton (1.4 m^3/tonne). Production and experimental data, however suggests that considerable free gas exists in the Fort Union coals, which may more than double the reservoired gas. Carbon isotopic analyses suggest that gas of both the Ardley and Fort Union is mainly biogenic in origin.

Both the Fort Union and Ardley coals are poorly cleated (jointed) to non-cleated probably because of their low rank. The Fort Union coals have variable permeability. Injection tests commonly indicate values in the hundreds of millidarcies to in excess of 1 darcy. The high permeability of the Fort Union coals is due to major tectonic fracture sets. The permeability of the Ardley coals is largely unknown: tests to date suggest permeability values are substantially less than those encountered in the Powder River Basin.

Three major differences exist between the Ardley coals and those of the Fort Union: 1) Ardley coals have received little exploration; 2) Fort Union coals are thicker; and 3) the Powder River Basin is bounded by Laramide uplifted basement blocks and the areas of highest production and permeability is correlated with fracturing associated with major tectonic features. To date no tested Ardley coal has comparable permeability to the most productive Fort Union coals, however little exploration or appropriate testing has taken place. Although there is less cumulative coal in the Ardley, many seams are as thick or thicker than many highly productive (>200 mcf/day, $>5.7 \cdot 10^3 m^3$/day) coals in the Powder River Basin