Coalbed Methane and CO_2 Sequestration Characterization of Coalfields in Nova Scotia

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ABSTRACT

Nova Scotia has extensive resources of Carboniferous age coal in the Cumberland, Pictou and Sydney coalfields. These coalfields have been mined by underground and more recently surface methods for more than a century. Interest in the coalbed methane potential of these coalfields began in the mid-1990's with exploration in both the Cumberland and Pictou coalfields. More recently, with the signing of the Kyoto Protocol, these coals have attracted attention as potential reservoirs for the storage of CO_2.

An extensive study of both the coalbed methane and CO_2 sequestration potential of these coalfields was initiated with funding from the Canadian Clean Power Coalition, Nova Scotia Department of Natural Resources and Natural Resources Canada. Sampling was conducted in the field and at the Stellarton core storage facility to obtain representative coal samples for characterization of methane and CO_2 adsorption characteristics utilizing isotherm experiments. As CO_2 is particularly sensitive to temperature, being near the phase boundary at the pressure and temperature conditions in these coalfields, isotherms for CO_2 were conducted at 15, 20 and 25 Celsius, whereas methane isotherms were conducted at 20 Celsius. Three dimensional computer models developed from more than 2000 boreholes as well as mine workings and outcrop information were utilized to determine the depth, thickness and quality of all coal seams in the three coalfields. Temperature and pressure gradients were then utilized to determine the reservoir conditions for each coal seam at grid node spacings of from 50 to 200 metres. The Langmuir parameters determined from the isotherm analyses were applied to determine adsorption capacity for methane and CO_2 at each grid node in the computer models. In some cases, CO_2 was determined to be in the liquid phase, in which case storage capacity was assumed to be a function of the porosity and fracture volume of the coal. The old mine workings presented a problem in that coals near them could have been degassed during the operation of the mines, and CO_2 injected near them could potentially escape into the workings. Accordingly, a 400 metre buffer was incorporated around the mine workings and excluded from the analysis.

The volume of methane (given 100% saturation) and CO_2 storage volume was computed and subdivided by depth and reservoir quality (defined by volume per unit area). Maximum prospective coalbed methane resources amount to 1.6 trillion cubic feet with a potential maximum CO_2 storage volume in the order of 290 megatonnes. The proportion of these volumes that could be viably accessed, however, is expected to be much smaller.