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Co-Production of Gas from Coals and Shales in the Horseshoe Canyon Formation

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The total gas-in-place in the Horseshoe Canyon-Belly River Formation coal measures in Alberta are assessed and the reserves and spacing units are assigned based on canister desorption tests of coal. Substantial gas; however, also occurs in the free state (and some in solution) within the coals as well as adsorbed and in the free state (and some in solution) within adjacent fine-grained strata (referred to here as shales) interbedded with the coals. A series of laboratory experiments were conducted to quantify the reservoir properties of the coals and shales and were integrated with the results from field tests to be used as model inputs for a general equations-of-state reservoir simulator (CMG's GEM). The purpose of the modelling was to address two main questions: 1) do variations in the amount of free gas within the matrix porosity of the coal seams affect production? and 2) to what extent is the gas stored within the strata interbedded with the coal seams co-produced?

Free gas stored in a coal seam with an effective matrix porosity of 8% is shown to comprise on the order of 25% of the total original gas-in-place. The results of the simulations show that for high permeability coals (150 mD), the entire additional gas-in-place (within 1%) resulting from the free gas is produced after 25 years. Even a very low permeability reservoir (0.3 mD) is modeled to observe an ~2% increase in cumulative gas after 50 years of production.

Adding the gas bearing shales to the coal seams results in a substantial increase in producible gas. An increase of 144% in the cumulative gas produced after 50 years is observed when shales with a fracture permeability of 0.01 mD, matrix permeability of 1×10^{-4} mD, and a fracture spacing of 10 m are included with coal seams with a fracture permeability of 15 mD. The coal seams, being more permeable than the shales, act as horizontal drains for over and underlying strata. The enhanced production is strongly dependent on the fracture and matrix permeability and fracture spacing of the shales. The spacing of 4 wells/section assumed in the above model, results in an estimated ultimate recovery (EUR) of 23% in the coals after 50 years production and 9% in the shales. Downsizing to 8 wells/section increases the EUR to 35% for the coals and 15% for the shales and to 16 wells/section to 50% for the coals and 22% for the shales after 50 years production. The resulting increase in cumulative production with the decrease to 8 wells/section spacing is 57% after 50 years and an additional 42% when further decreased to 16 wells/section.