Ardley Coal Zone Reservoir Characterization and Post-Scollard Structural Re-Arrangements in the Edson CBM Exploration Block, Alberta

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The economic importance of coal-bed methane (CBM) in the Ardley Coal Zone, associated with the emerging environmental issues of potential CO_2 storage/sequestration in coal have led the Alberta Geological Survey to undertake a regional study of the Ardley coal reservoir conditions in the Edson CBM exploration block.

The stratigraphic study resulted in the recognition of five fluvial sequences within the Scollard succession, which are interpreted as dynamic responses to cyclic slow thrusting phases in the orogen followed by isostatic rebounding. Each of the upper four sequences is capped by laterally continuous coal strata named here 'N', 'Ml', 'Mu' and 'S' coal sub-zones, making up the Ardley Coal Zone. Each of the coal sub-zones can be considered an individual reservoir due to particular geometry and sealing characteristics. The examined drillcores show that 'banded coal' category is the dominant type of coal in the Edson block. Cleats free of calcite infilling are dominant. Vitrinite reflectance is 0.54-0.59% within the onset of hydrocarbon generation. The coal fracture system inferred from the identified DEM lineaments suggest two areas of potential 'two-face-cleats systems' located on either side of the Athabasca River.

Two categories of reservoir rocks have been identified within the Scollard succession: the coal strata as unconventional reservoirs, and sandstone channels as potential conventional reservoirs. Both categories have inherent permeability. Locally, the direct stratigraphic contacts of the two types of reservoirs associated with differential lithological compaction suggest reservoir-connectivity and may be considered pathways for gas migration in the CO_2-ECBM strategy. The vertical connectivity of the reservoir units is amplified in the Edson CBM exploration block by post-Scollard structural re-adjustments. The post-Scollard structural re-adjustments are interpreted based on a set of three successive structural maps generated at the top of the Battle Formation, the top of the coal-barring part of the Scollard Formation and at the top of the Scollard Formation. All three structural maps reveal a consistent northwest-southeast trend of a narrow zone of structural low flanked by two areas of structural high. In contrast, the isopach map of the Scollard Formation shows a gradual but substantial increase in thickness towards the southwest. This consistent thickening clastic prism suggests that the elongated structural low formed after the deposition of the Scollard Formation (post-lower Paleocene). The analysis of structural maps corroborated with outcrop and core observations suggests strong vertical hydraulic connectivity among the reservoirs in the Edson block, consistent with the open system character of the Ardley

coal zone as a part of Scollard-Paskapoo unconfined aquifer. Therefore, in the Edson block, the suitability for CO_2 sequestration in the Ardley coal zone is limited by the increased vertical connectivity of the reservoir units due to post-depositional structural re-adjustments.