Subsurface CO2 Storage in Nova Scotia, Eastern Canada

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The most significant sources of CO2 in Nova Scotia are hydrocarbon-burning power plants with annual emissions of nearly 10 million tonnes of CO2. The Maritime Provinces have a long geological history with several candidate Paleozoic and Cenozoic basins for CO2 storage. Salt can form an excellent seal to potential reservoirs and there are two salt systems, the Paleozoic Windsor Group and the Mesozoic Argo Formation. Several carbonate and clastic reservoirs are candidates for storage in addition to potential storage opportunities in coal beds, sub-basalt, fractured shale, and the very low possibility of fractured granitoids.

In our ranking of potential sites (basins and formations) we have considered the economic constraints due to distance from the major source of CO2 emissions. The Orpheus Graben ranks as the preferred site but we do recognize that economic conditions may change the rankings. Final site selection requires detailed analysis of samples to discern storage capacity, including injectivity rates, lateral continuity and characterization of reservoirs to determine storage capacity, seal integrity, regional and local stress fields and the effect CO2 will have on the reservoir through time. Any site will require long term monitoring of the CO2 via wells and regular seismic surveys over the area (“4D”).

For site evaluation, reservoir and seals pairs are usually delineated with a high degree of confidence from logs and 3D seismic data. However subsurface geological data is seldom adequate to properly characterize the bedform scale in reservoirs needed to monitor the distribution of high volumes of injected CO2 and the potential diagenetic effects on reservoir performance over time. Our preferred approach is to use analog reservoir models developed from detailed outcrop study. We incorporate high resolution photography, LiDar, GPR (ground penetrating radar), scintillometer (Gamma Ray) and outcrop permeameter data, with bed-scale outcrop measurements of outcrop geometry to define the architectural elements that are input to geologic and reservoir models using Schlumberger Petrel and Eclipse. Outcrop samples are examined petrographically to enhance our understanding of potential diagenetic effects at bed contacts coupled with detailed measurement of effective and ineffective porosity and permeability. These are used to populate detailed geological and reservoir models for simulation of various fluid types and injection strategies through time.