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Unlocking Cambrian Potential: A New Frontier for CO_2 Storage in Southern Ontario

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Summary

The National CCUS Assessment Framework (NCAF) project focuses on identifying and developing cost-effective, environmentally sustainable solutions for decarbonizing eastern Canada. As part of this effort, the NCAF project has identified several locations for CO_2 capture in southern Ontario along the shores of Lake Erie, with the goal of connecting them to CO_2 storage reservoirs. While significant storage potential is believed to exist offshore Nova Scotia and Newfoundland, these areas have yet to be thoroughly characterized. The current study was initiated to identify and evaluate suitable storage hubs closer to CO_2 capture sites within the Cambrian sedimentary section along the shorelines and offshore of Lake Erie.
The study leveraged publicly available data and the clustering module of the software GAMLS (Geologic Analysis via Maximum Likelihood System) to identify rock-type endmembers within the Cambrian section of the study area, enabling seamless spatial correlations between wells. Detailed core descriptions, XRF analysis, and publicly available routine core analysis data (including porosity and permeability) were employed to validate the model and evaluate reservoir suitability for CO_2 injection. Additionally, the output from GAMLS (1D, 2D) was imported into Petrel to generate a 3D geomodel of the study area. This model will be used to assess storage volumes and CO_2 injectivity across different regions, conduct sensitivity analysis for missing data (such as relative permeability for CO_2 in the Cambrian rocks of southern Ontario), and inform cost analysis, risk assessment, and strategic planning for CO_2 capture in eastern Canada.

Theory / Method / Workflow

The study utilized publicly available data from the Ontario Geological Survey Repository (OGSR), including well-logs and core analyses of porosity, permeability, and fluid saturation. Gamma ray (GR), bulk density, and neutron porosity logs were imported into GAMLS, where formation tops were selected. The data was then standardized to ensure that variations in log values reflected true geological differences rather than inconsistencies in tool calibration or operational conditions. Following a robust quality control process, clustering was performed to identify rock type endmembers, and the section was divided into internal flow units that were petrophysically characterized. Once the model was validated against core descriptions and XRF analysis, the information was imported into Petrel. In Petrel, formation tops were connected into surfaces, and a geomodel grid was populated with petrophysical properties using routine upscaling procedures.

Results, Observations, Conclusions

The model incorporates data from 82 wells and identifies four rock type endmembers through initial clustering: two sandstone, one siltstone, and one dolostone (Figure 1). The Cambrian section within the study area, equivalent to the Mount Simon Formation, primarily consists of fine to medium sand interbedded with dolostone. Two sections were identified as potentially suitable

for CO_2 injection: the lowermost sand below the top NV5 and the sandy-silty section between tops NV1 and NV4 (Figure 1). While the lateral continuity of individual sand beds in the upper section appears limited, the model suggests good continuity within the silty section (green) and the basal sand. The basal sand unit thickens, and the silty layer transitions to a sandier composition towards the southwest and northeast ends of Lake Erie. With higher porosity and permeability observed in the sandy units compared to the dolostones, these findings suggest greater storage potential away from the central section of the lake. To further evaluate injectivity in different areas of the model, 3D models are being investigated.

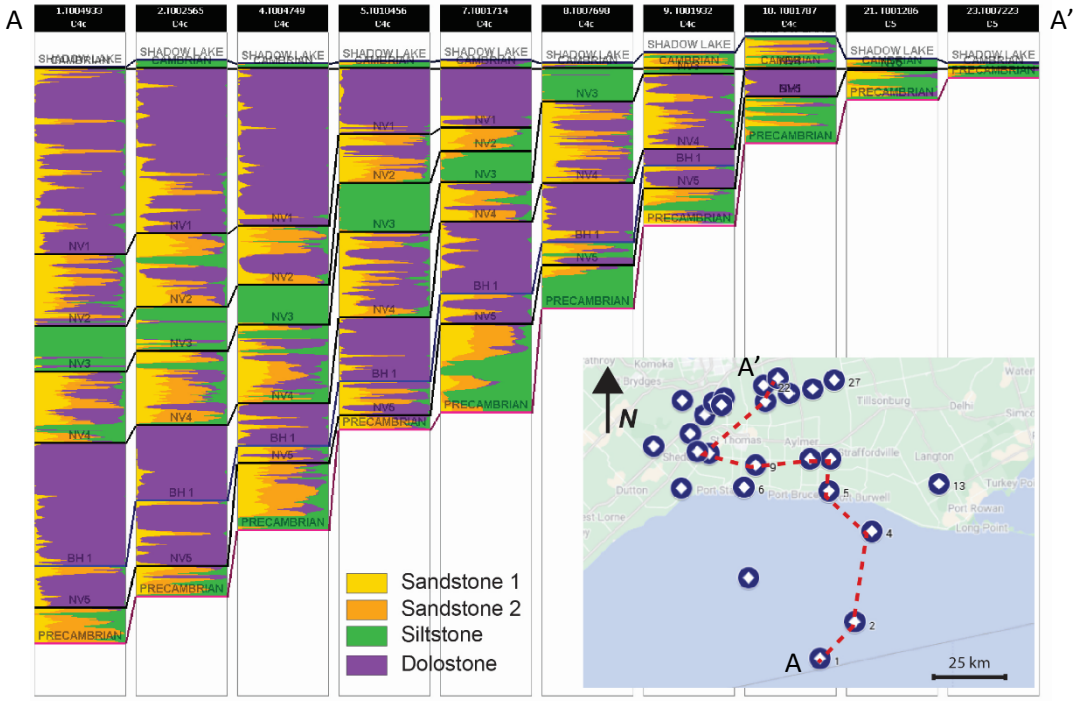

Figure 1: *A north-south cross section from the center of Lake Erie to the edge of the Cambrian section (insert) showing results of the initial cluster run. Four rock types were identified- two sandstones, a siltstone and a dolostone. Potential injection target include the basal sand, below internal top NV5, and the sandy- silty units between internal tops NV1 and NV4.*

Novel/Additive Information

This is the first geomodel generated for the grater Lake Erie area to investigate CO_2 storage potential.