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CO2 storage in depleted gas reservoirs in northeast Alberta: storage site selection and ranking

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Summary

Oilsands operations emitted approximately 81 Mt of carbon dioxide in 2022 and are the major GHG emitters in the country (ECCC, 2024). CCS is a promising, but costly mitigation strategy. It requires huge CAPEX for infrastructure, long construction time, and a coordinated effort from industry, governments, and society. In addition, CCS projects generate CO_2 as well. The longer the pipeline, the deeper the storage aquifer and the higher the injection pressure, the more secondary CO_2 will be generated. There are thousands under-pressured gas reservoirs close to the major industry GHG emission sources in oilsands area, which are hydraulically isolated from regional aquifers by their physical traps, low risk in leaking in steady state. The inefficiency of storage capacity due to storage in gas phase can be compensated by higher porosity with well-characterized reservoir and additional storages from compressing gases in residual and sub-economic gas intervals if operating at regional hydrostatic or safe operation pressures, in additional to low-cost in drilling, injection and transportation (Chen 2025). These depleted gas reservoirs in oilsands area can be both a short-term alternative and long-term complement for carbon removal.

This study develops criteria for selecting suitable CO2 storage sites from the depleted gas pools in northeast Alberta and ranks the selected pools on the basis that optimizes storage and injection performance and minimizes containment and economic risks and environmental impacts. A three-step workflow was proposed, which includes an initial assessment of storage, prospectivity screening of suitability and multi-criteria ranking. The suitable pools were re-organized into clusters by their spatial affinity of occurrences. Each cluster consists of multiple discrete, hydraulically isolated and vertically overlapping reservoirs and used as a basic unit for ranking. Several ranking algorithms were tested, the TOPSIS (Technique for order of preference by similarity to ideal solution) seems to perform the best. Applied to the depleted gas pools in northeast Albert, the potential candidates are reduced from 4694 down to 341 pools that are aggregated into geographic clusters in 6 fields. All 6 clusters are in 100 km

range from nearest emitter (source), and the shortest Source to Sink distance is only 9 kms. Among the storage clusters, the smallest cluster has the storage potential of 38 Mt CO2, and the largest over 200 Mt CO2 with a total capacity up to 768 Mt storage.

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References

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