

# CO<sub>2</sub> Sequestration Potential of the Basal Sandstone Member, Moose Channel Formation, Mackenzie Delta, Canada"

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## Introduction

This study evaluates the potential of the Moose Channel Formation in the Mackenzie Delta, Northwest Territories, for CO<sub>2</sub> sequestration, focusing on the contribution of cracks and fractures to total reservoir porosity and estimation of the caprock integrity of the overburden. The Late Cretaceous (Eocene (90 – 40 ma) Moose Channel formation (MCF), which elongates SW to NE for approximately 163 kilometers beneath the central Mackenzie Delta, is overlain by clay-rich Cenozoic deltaic sequences, which can potentially serve as caprocks for CO<sub>2</sub> storage. MCF is exposed at the BFC-1 field station, located in the Big Fish Creek Canyon (Figure 1a), and was surveyed by the Energy Group of the Northwest Territories Geological Survey (NTGS) in the Summers of 2023 and 2024.

## Method

This study combines field measurements of rock physical attributes at BFC-1 with traditional workflows for seismic data interpretation, structural modeling, petrophysical analysis, and property modeling. Fracture porosity was analyzed using Photogrammetry Spectral Analysis with ImageJ software to process high-definition images of rock outcrops. Fracture density was estimated as the ratio of fracture number, length, and aperture to the area of interest, with fracture porosity linearly related to fracture density. Litho-facies analysis used petrophysical data from well logs and history files, including lithologic descriptions. The Gamma Ray Index (IGR) and shale volume (V<sub>shale</sub>) were estimated using the Clavier method and then integrated into the structural model. Capillary Entry Pressure (P<sub>c</sub>) and permeability were estimated using empirical relationships.

## Observations

The V<sub>shale</sub> model provides a critical framework for understanding the caprock formations in this study, linking porosity, permeability, and capillary entry pressure to the sealing capacity of the caprock. Fracture porosity ( $\phi_f$ ) values vary from 0% in shale-dominated areas (with V<sub>shale</sub> near 100%) to 16.43% in cleaner sandstone zones (V<sub>shale</sub> approaching 0%). An empirical coefficient ( $\alpha = 0.1431$ ), which quantifies the reduction in fracture porosity due to shale content, was derived from the  $\phi_f$  vs. V<sub>shale</sub> plot and used to model fracture porosity throughout the study interval. The combined fracture and matrix porosities yielded total reservoir porosity ( $\phi_t$ ) P10 and P90 values ranging from 22.02% to 32.35%, reflecting the reservoir's porosity variability. The caprock, with more than 50 meters of deltaic sediments and a V<sub>shale</sub> of 54%, demonstrates strong sealing potential over the Basal Sandstone Member of the Moose Channel Formation (Figure 1b). The high shale content enhances its effectiveness as a CO<sub>2</sub> barrier, as supported by acceptable SPQI values. Its capillary entry pressure exceeds 1 MPa, confirming its resistance to fluid migration and reinforcing its suitability for CO<sub>2</sub> storage (Figure 1c). The caprock's permeability, constrained by

thick shaly units, remains well below the 0.1 mD threshold, further emphasizing its sealing capacity (Figure 1d).

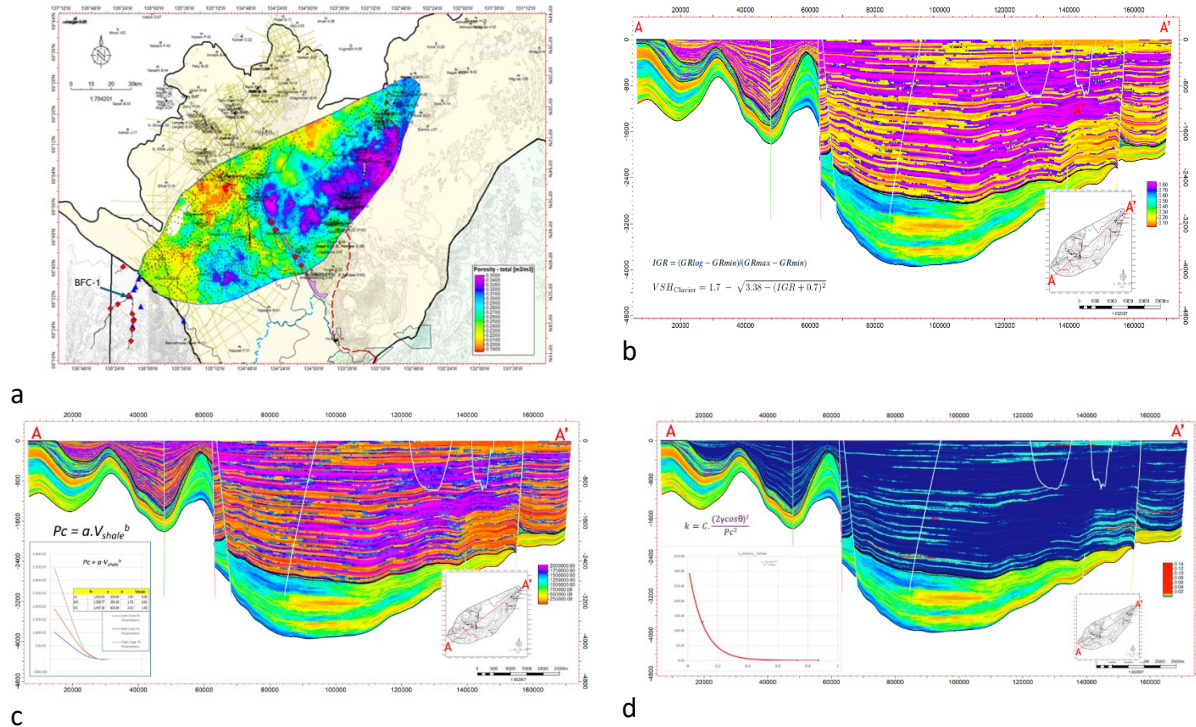


Figure 1: (a) Study area map – showing the total porosity attribute of the Moose Channel Formation Basal Sandstone Member. (b) Vshale X-section (c) Capillary Entry Pressure -Pc (d) Permeability X-cross section through the Formation Basal Sandstone Member of Moose Channel Formation Basal Sandstone Member.

## Conclusions

The Basal Sandstone Member of the Moose Channel Formation is considered a prime candidate for developing workflows to assess other reservoirs in the region. Ongoing reservoir engineering efforts will complement the petrophysical analysis, aiding further evaluation of this and similar reservoirs for CO<sub>2</sub> storage.