

Scientific Commentary on the hydrocarbon potential of the proposed Sarvajuaq Marine Protected Area Nunavut.

Adebukonla Kalejaiye, MSc.

adebukonla.kalejaiye@NRCan-RNCan.gc.ca

Petroleum Geophysicist

Natural Resources Canada - Geological Survey of Canada

Oksana Khriashchevska, Ph.D.

oksana.khriashchevska@nrcan-rncan.gc.ca

Energy Resource Analyst

Natural Resources Canada - Geological Survey of Canada

This commentary is a follow up to the version released in January 2024, based on updated interpretation of newly available third party 2D seismic data, a review of the hydrocarbon assessment on the conjugate West Greenland Margin and an open file on source rock potential of formations on Bylot Island.

The Sarvajuaq area, largely underlain by the Nares Strait in the North and Baffin Bay in the south (Figure 1), was identified for potential conservation by Fisheries and Oceans Canada. This area has been qualitatively assessed by the Marine Conservation Targets (MCT) team for hydrocarbon potential and a scientific commentary released to summarize findings.

Nares Strait: This area was studied by the MCT team in 2023. It is underlain mainly by the Franklinian Basin which preserves Neoproterozoic–Devonian strata characterized by a thin, flat-lying, shallow water clastic to carbonate succession that unconformably overlies the Canadian Shield. Other smaller, Mesozoic–Cenozoic sedimentary basins consisting mainly of conglomerates, sandstones, siltstones and dark shales of the Eurekan Sound Group, deposited in non-marine to shallow marine environments exist within the study area under Nares Strait. Five potential plays were assessed with resulting qualitative hydrocarbon resource maps indicating that the area has low hydrocarbon potential (Figure 2). Seal breach or absence is the most common risk associated with the plays in this area. This is premised on the age of the sediments and the effects of the Ellesmerian and Eurekan Orogenies which could have triggered a migration or loss of previously generated hydrocarbon. See Figure 3 for summary of hydrocarbon plays in Nares Strait.

Baffin Bay: This area was reassessed by the MCT team in 2024 based on newly available data. The oldest sediments within the study area are expected to be present as isolated erosional remnants of Lower Paleozoic carbonate rocks. These rocks outcrop on the surrounding islands, where they onlap the weathered Precambrian basement. This is followed by a thick succession of up to 8 km of Mesozoic–Cenozoic clastic deposits associated with early rifting and the development of the Baffin Fan respectively. The southern part of the Sarvajuaq area of interest (AOI) is mostly covered by the Baffin Fan; an area of approximately 92,000 km² of over 8 km thick sediments deposited on continental and oceanic crusts. These sediments are mainly sourced from continental-scale rivers feeding through Lancaster Sound, Jones Sound, and Nares Strait during Thanetian to Pleistocene time. Structural traps are expected to be formed during the Cretaceous rifting and during the Eocene Eurekan orogeny which led to the formation of inverted anticlines over horst blocks as seen in Lady Ann and Lancaster Sound grabens.

Six potential plays were identified in the AOI with resulting qualitative hydrocarbon resource maps indicating that the area has low - medium hydrocarbon potential (Figure 2). The medium potential is mainly expected in the Baffin Fan with probable hydrocarbon indicators observed on seismic while low

potential is mainly expected on basement highs due to uncertainty of sediments presence. Though the qualitative assessment reflects low-medium hydrocarbon potential, quantitatively the Sarvajuaq AOI may contain significant hydrocarbon resources as studies of analogous fans around the world reveal that these plays are prolific when present. The presence of active petroleum systems in the study area is also supported by petroleum seeps in Scott Inlet (MacLean et al., 1981) and Buchan Gulf (Levy et al, 1981). The lower Paleozoic play has the lowest chance of success due to presence uncertainty and depth of burial. See Figure 4 for summary of hydrocarbon plays represented in the Baffin Bay.

Upcoming work: An open file detailing the results of the latest qualitative and quantitative assessments in the Baffin Bay is in progress and will be released before the end of Q1 2025.

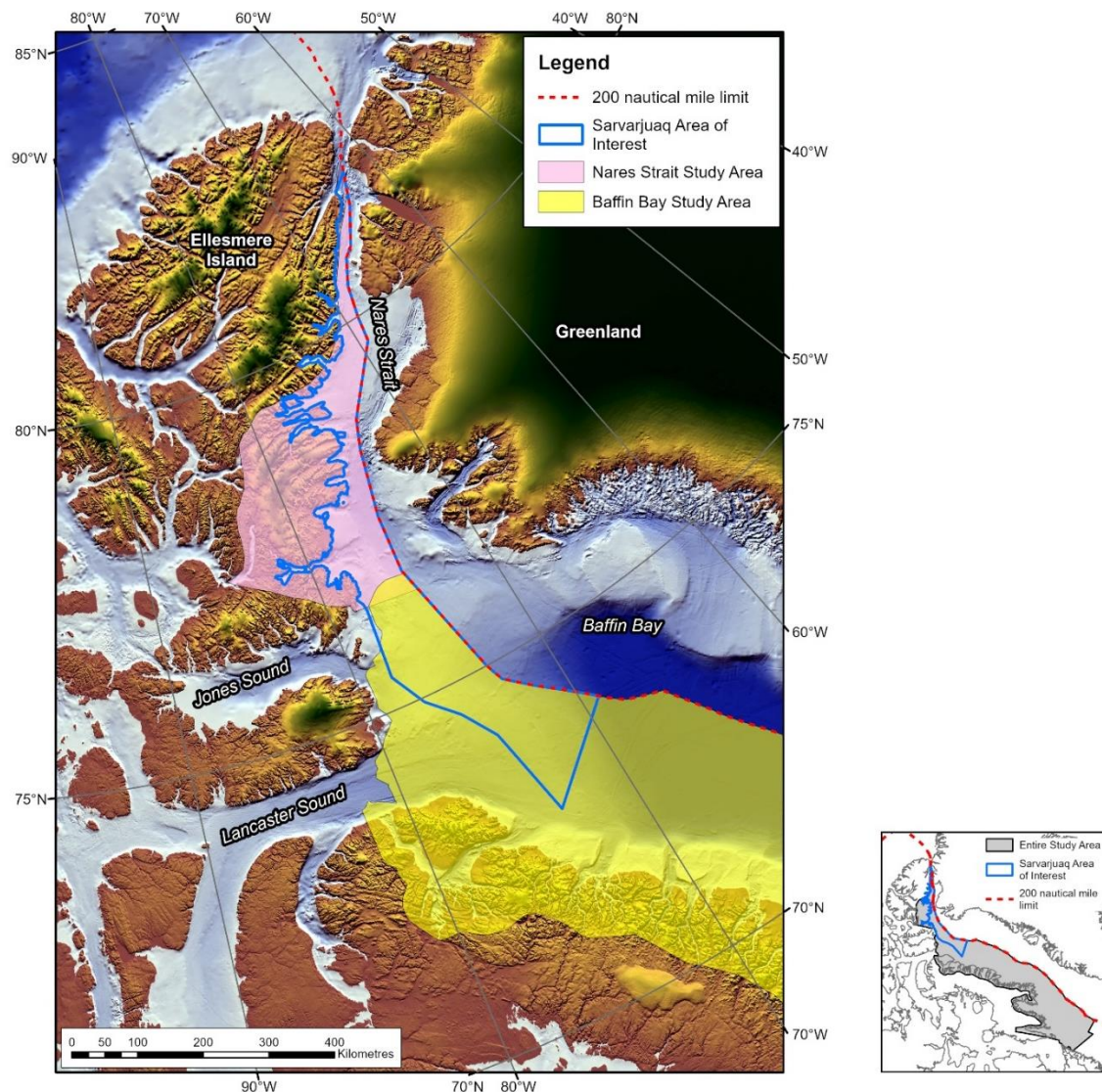


Figure 1. Location map showing the two MCT team hydrocarbon assessments covering the proposed Sarvajuaq Marine Protected Area Nunavut. Nares Strait study carried out in 2023 and Baffin Bay reassessment study carried out in 2024.

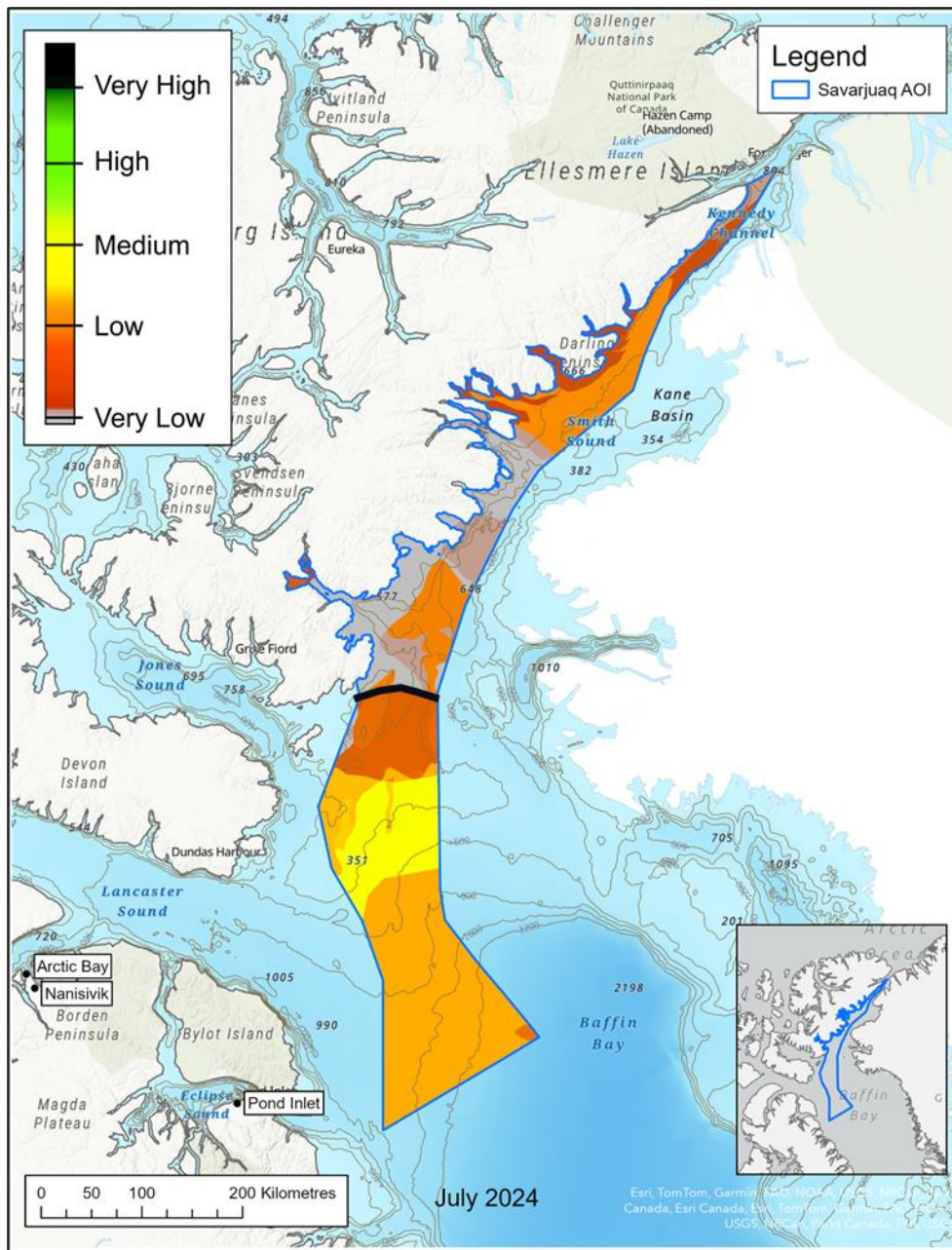


Figure 2. Hydrocarbon potential of proposed Sarvajuaq Marine Protected Area, from Kalejaiye et al. (2023) and 2024 reassessment of Baffin Bay. Grey area on the map is underlain by ancient rock of the Canadian Shield and has no hydrocarbon potential. The hydrocarbon potential of the areas in red are Very Low to Low while areas in orange and yellow have medium hydrocarbon potentials. Black line on map shows the two open files boundaries in the Sarvajuaq AOI.

Age (Ma)	Play	Source	Reservoir	Trap	Seal	Highest uncertainty	GSF (0-1)
61	Paleogene	Christopher, Kanguk	Clastics (Eurekan Sound group)	Stratigraphic/ small offset faults, folds	Intraformational Shales of Pavy Fm, Cape Back	Seal	0.50
120	Cretaceous	Christopher, Coals of Isachsen	Isachsen, Hassel	Structural (small offset faults, folds)	Shale (Christopher, Kanguk)	Source quality	0.50
435	Sillurian - Devonian?	Cape Phillips, Eids, Ibbet Bay?	Carbonates, Clastics (Allen Bay, Danish River, Barrow inlet, Blue Fiords)	Stratigraphic / Structural small offset faults, folds	Shales (Eids, Cape de Bray)	Timing of trap formation / Seal	0.40
458	Cambro-Ordovician	Hazen, Kukersite	Carbonates (Cass Fjord, Cape clay, Eleanor River, Thumb Mountain)	Stratigraphic / Structural folds	Tight Carbonates, Shales, salt (Baumann Fiord Formation, Bay Fiord, Irene Bay Formation, Cape Phillips)	Timing of trap formation	0.40
999	Proterozoic structural	Smith Sound, Nares Strait groups	Clastics of Smith Sound, Nares Strait, Baffin Bay groups	Fault bounded blocks	Shales and basaltic volcanic rocks of the lower Thule Supergroup	Source/ Preservation	0.50
Presence and Quality			High	Medium	Low		

Figure 3. Summary of the hydrocarbon plays in Nares Strait/central Ellesmere Island.

Age (Ma)	Play	Source	Reservoir	Trap	Seal	Highest uncertainty	GSF (0-1)
15	Upper Cenozoic	Paleogene and Cretaceous / Cenozoic biogenic gas	Upper Cenozoic	Structural / stratigraphic	Intraformational mudstone	Reservoir quality	0.4
61	Cenozoic Baffin Fan	Paleogene and Cretaceous / Cenozoic biogenic gas	Cenozoic fan deposits	Stratigraphic	Intraformational mudstone	Source	0.7
61	Lower Cenozoic	Cartwright (upper Paleocene) and Kenamu (Eocene) formations, mid-Eocene Azolla layer	Lower Cenozoic sandstone, analogues of Paleogene Gudrid and Leif sands	Structural / stratigraphic	Kenamu (Eocene), Mokami (upper Eocene – Oligocene) formations	Reservoir quality	0.9
100	Upper Cretaceous	Cenomanian – Turonian	Upper Cretaceous sandstone – analogues to Freydis sandstone unit	Structural fault-related / stratigraphic	Itilli, Ikermiut, Eqalulik formations	Reservoir quality	0.7
121	Lower Cretaceous	Albian	Aptian(?)–Albian sandstone equivalents of Quqaluit, Bjarni, Hassel formations	Structural fault-related / stratigraphic	Cenomanian – Turonian mudstone	Source	0.8
470	Lower Paleozoic	Upper Ordovician	Ordovician clastics, reefs, Lower Silurian hydrothermal dolostone	Stratigraphic (reef) / hydrothermal dolostones / structural	Tight carbonates / Upper Cretaceous shale	Source	0.4
Presence and Quality			High	Medium	Low		

Figure 4. Summary of the hydrocarbon plays in Baffin Bay.

Geological Survey of Canada Technical reports on the hydrocarbon potential of proposed Sarvajuaq Marine Protected Area.

Available for free download from www.geoscan.nrcan.gc.ca.

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