CHAPTER 6 – EASTERN ARCTIC

LANCASTER SOUND BASIN

Age	Early Cretaceous(?)-Tertiary over Proterozoic to Paleozoic basement
Maximum Basin Thickness	8 km
Discoveries	None
Basin Type	Mesozoic rift basin overlying Proterozoic to Paleozoic basin floor
Depositional Setting	Fluvio-deltaic to marine
Reservoirs	?Cretaceous and Paleogene sandstones, ?Palaeozoic sandstones and carbonates, ?Proterozoic sandstones
Regional Structure	Block faulting, half-grabens
Seals	?Marine shales
Source Rocks	?Lower Cretaceous (gas prone) ?Upper Cretaceous, Paleocene marine shales (oil potential)
Depth to Oil Window	Unknown
Seismic Coverage	In excess of 60 000 km of marine seismic form an adequate seismic grid
Area	13,250 km²
Area under Licence	931,640 ha (Exploration Licence held under moratorium)

(Water depths reach 800 m, and are generally in excess of 100 m, except within a narrow coastal zone. Ice cover extends from October to late June. Icebergs are common.)

This undrilled basin is a Mesozoic and Cenozoic rift basin comparable in size to the Viking Graben in the North Sea. It contains numerous block faulted structures identified on the basis of an extensive seismic grid. The basin stratigraphy is expected to include Cretaceous and Tertiary reservoir rocks, and mature source rocks for both gas and oil.

Geological Setting (Figs. 62-64)

Lancaster Sound Basin connects the partially drowned interior of the North American craton – the Canadian Arctic Islands – with Baffin Bay and the North Atlantic. The basin originated as a rift at the northwestern end of Baffin Bay. Unlike Baffin Bay, the continental crust in Lancaster Sound has not been significantly thinned and no sea-floor spreading has taken place. The fill of the basin consists of Mesozoic, Tertiary and Quaternary sediments and is bordered to the north and south by Proterozoic and lower Paleozoic rocks exposed on Devon Island to the north and on Bylot Island and the Borden Peninsula of Baffin Island to the south. In cross-section, the basin is a half-graben with the basin axis adjacent to the Devon Fault. The displacement of several thousand metres on this fault throws Proterozoic rocks exposed on Devon island against Mesozoic to Tertiary basin-fill. The basin shallows to the west into Barrow Strait and also to the east across the Sherrard Ridge, which acts as a sill separating Lancaster Sound and Baffin Bay basins.

Exploration History

Exploration for oil and gas has been limited to seismic operations and geological field work along the margins of the basin. Although drilling in Lancaster Sound was approved in principle in 1974, no well was drilled. A

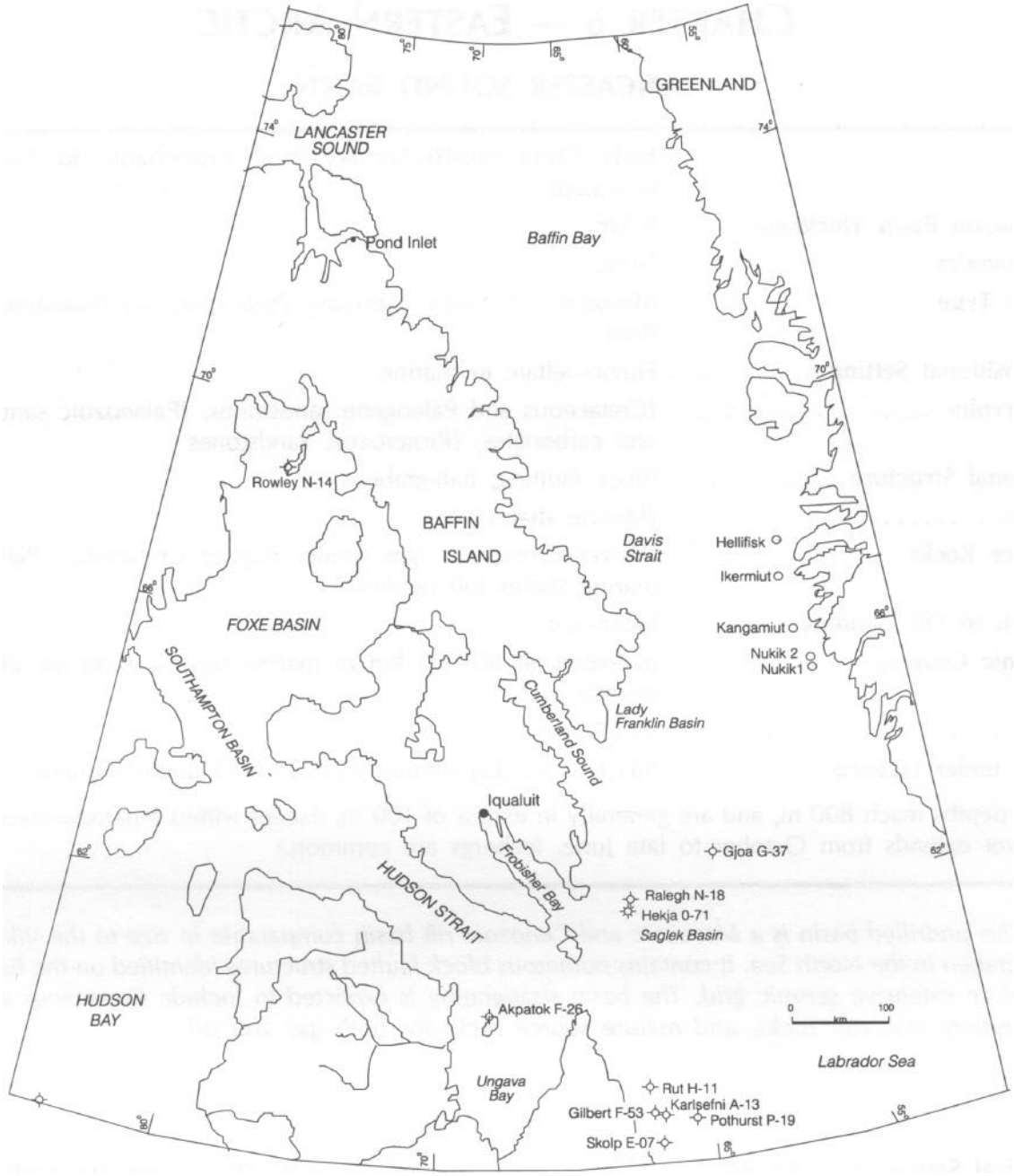

Figure 62. *Geography and well locations, eastern Arctic.*

moratorium on drilling was put in place following an environmental review in 1978. However, the Lancaster Sound Regional Land Use Plan considered that hydrocarbon exploration was not necessarily an incompatible land use.

Exploration rights held in the area are not subject to work programs while the moratorium is still in effect.

Stratigraphy (Fig. 65)

Archean rocks exposed along the length of Baffin Island, eastern Devon Island and eastern Ellesmere Island form an uplifted margin to Baffin Bay from which the Proterozoic and Lower Paleozoic cover has been largely stripped. The Cambrian to Middle Silurian succession has been described from the southwestern

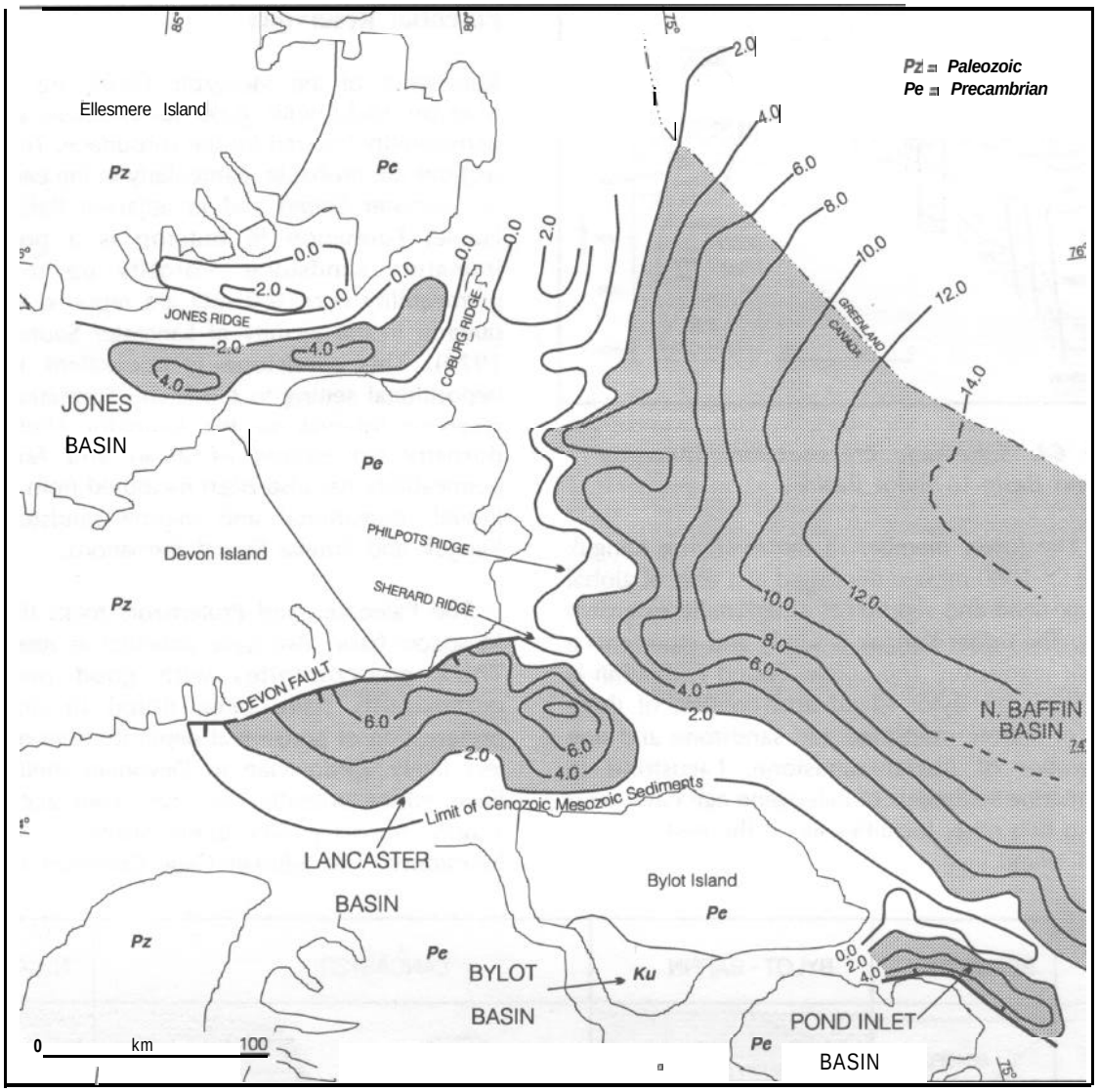

Figure 63. *Isopach (thousands of metres) of Mesozoic-Cenozoic strata, Lancaster Sound and adjacent areas.*

margin of the Lancaster Sound Basin (Jackson and Sangster, 1987). This consists of predominantly clastic Cambrian strata (Gallery and Turner Cliffs formations) superseded by limestones and dolostones of the Lower Ordovician (Ship Point Formation). Devonian formations (the Allen Bay and Blue Fiord) may be preserved in the western end of the basin. From these observations, it is probable that the Mesozoic basins in Lancaster Sound, Jones Sound and Eclipse Trough are floored by Proterozoic rocks in the east, with lower Paleozoic rocks preserved farther west beneath a major sub-Cretaceous unconformity.

Cretaceous to Tertiary sediments outcrop on Bylot Island and adjacent to Pond Inlet on northeastern Baffin Island. The fill of the Lancaster Sound Basin has been inferred from the outcrop stratigraphy on Bylot Island (McWhae, 1979) and the seismo-stratigraphy of the basin sequences by Harper and Woodcock (1980). The oldest Mesozoic sediments in Lancaster Sound are probably Albian or possibly older in the deepest parts of the rift. Strata of the Hassel Formation (Albian-Cenomanian), the Kanguk Formation (Campanian-Maastrichtian), and the Eureka Sound Formation (Paleocene-Eocene) have nomenclature common to the Sverdrup Basin of the Arctic Islands and are likely to be represented as thickened successions in the offshore.

The Hassel Formation is predominantly fluvial. Thick, coarse grained sandstones with thin coals are equivalent to the sandstones of the Bjarni Formation

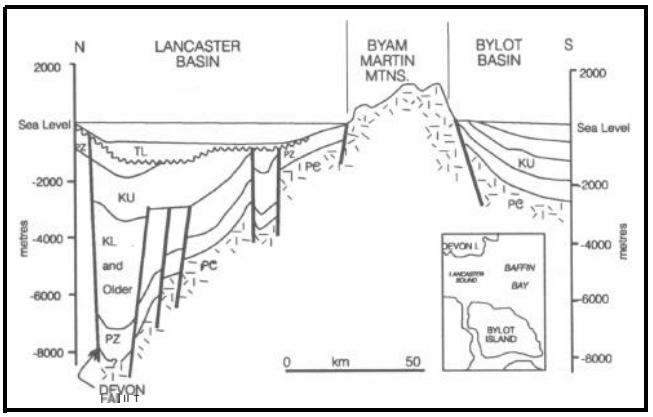

Figure 64. *Schematic cross-section, Lancaster Sound Basin to Bylot Basin.*

offshore. The lower member of the overlying Kanguk Formation (> 1000 m) was deposited at a time of global marine highstand and represents a regionally extensive shale unit. The upper Kanguk is sandy and represents a subsequent regression. The Eureka Sound Formation is 1600 m thick on Bylot Island and consists of three members of marine mudstone and sandstone and one thick member of fluvial sandstone. Lacustrine to marginal marine sediments of Paleogene age have been noted from two other localities along the east coast of the Baffin island.

Potential Reservoirs

Sandstones of the Mesozoic rift-fill are all potential reservoir rocks with good to excellent porosity and permeability inferred for the subsurface. Thick reservoir sections are probable, particularly in the eastern portion of Lancaster Sound and in adjacent Baffin Bay. The Hassel Formation in outcrop is a poorly sorted immature sandstone. Porosity up to 28% and permeability over 400 mD are reported from surface outcrop in the vicinity of Lancaster Sound (McWhae, 1979). This sandstone is equivalent in age and depositional setting to the Bjarni Formation, a proven reservoir interval on the Labrador Shelf. Excellent porosity (in excess of 20%) and fair to good permeability has also been measured from interbedded fluvial, transitional and marine sandstones of the Kanguk and Eureka Sound formations.

The Paleozoic and Proterozoic rocks that floor the Mesozoic basin also have potential as reservoir rocks. Thick quartzarenites with good porosity and permeability have been noted in outcrop, but preservation of porosity at depth in these older units is less likely. Ordovician to Devonian shelf carbonates have minor potential for significant accumulations. Vuggy porosity has been noted in Ordovician limestones. The Silurian Cape Crawford Formation is

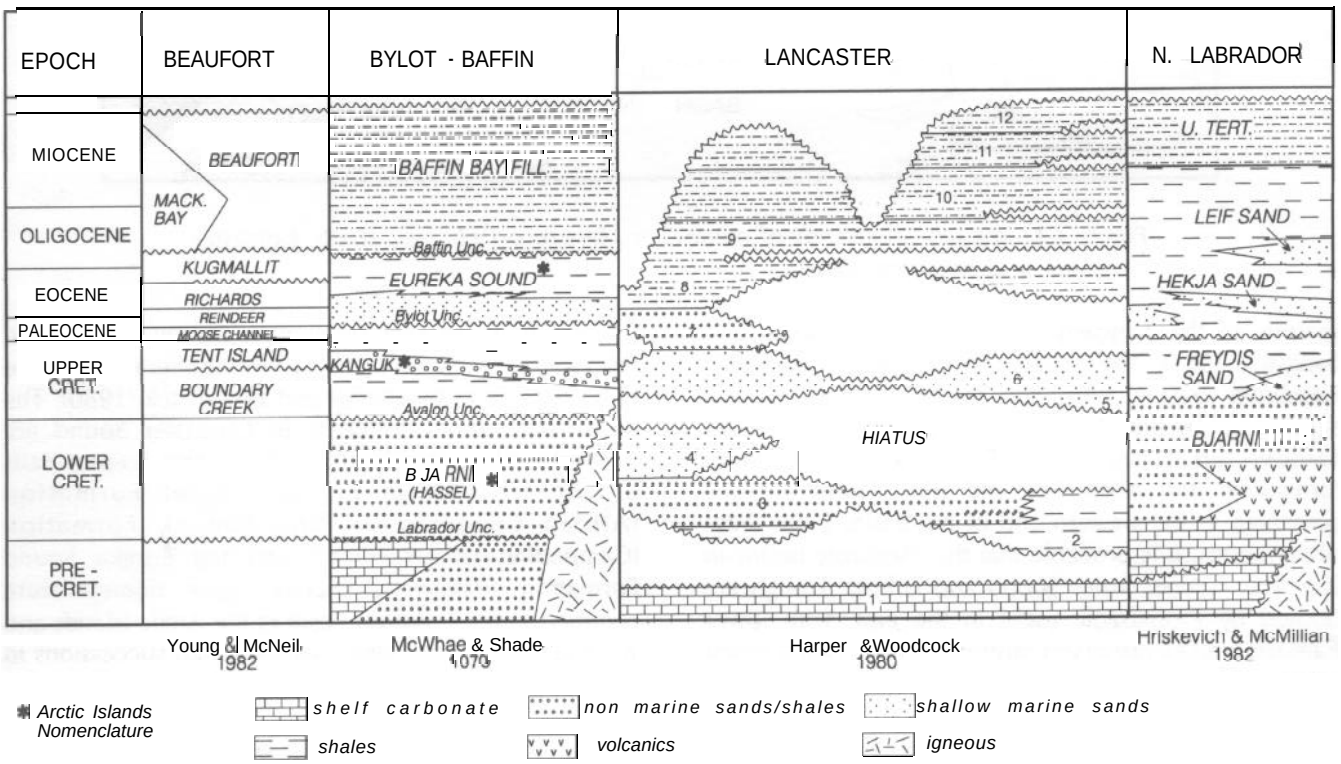

Figure 65. *inferred stratigraphy of Lancaster Sound Basin and comparison with other nearby basins and the Beaufort-Mackenzie Basin (after Smith et al., 7989).*

reported to have extensive intercrystalline and solution-collapse breccia porosity (McWhae, 1979). The Allen Bay and Middle Devonian Blue Fiord limestones also have potential for porosity development.

Structure, Traps and Seal

Numerous tilted fault blocks have been recognized on seismic. Most appear to have a long history of movement throughout the Cretaceous and have profoundly affected the deposition of stratigraphic intervals with reservoir potential. Many traps may therefore have a significant stratigraphic component indicated by onlap onto tilted fault blocks. High standing blocks may be truncated by unconformities within the Tertiary. Thick shale intervals in the fluvial to transitional depositional settings common in the Cretaceous and Tertiary are unlikely. Top seal across many of the high-standing fault blocks must therefore be suspect. Fault reactivation may further adversely affect seal integrity.

Source Rocks

Paleozoic source rocks may retain potential to generate hydrocarbons but lengthy exposure of the Paleozoic prior to the Cretaceous may have thoroughly oxidized potential source rocks. Source rock candidates within the Mesozoic succession may include marine shales (presence inferred from onlapping seismic sequences) and lacustrine sequences. Basin restriction by a seaward sill – possibly a recurrent feature at the mouth of Lancaster Sound – improves the possibility of source rock deposition in poorly oxygenated bottom waters. Outcrop sampling indicates that shales within the Bjarni Formation have very good gas-prone source rocks. Upper Cretaceous Kanguk shales have TOCs in excess of 2% and are potential oil source rocks.

Potential

Smith et al. (1989) rate the oil and gas potential of Lancaster Sound Basin as high, based on a review of the current state of knowledge. No new data of significance has been acquired since this study. It is clear that this basin fulfils many of the criteria of a petroliferous basin but that significant risk remains: specifically, source rock presence and maturity, seal integrity, breaching of traps and timing of migration. The similarity with the Labrador shelf, in particular the large terrestrial input to the basin, suggests that the basin may be gas rather than oil prone. However, in the absence of drilling, the basin must be considered to have significant potential for both oil and gas.

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BAFFIN BAY

Age	Cretaceous (Albian?) to Tertiary
Depth to Target Zones	Unknown
Maximum Basin Thickness	14 km (8 km average)
Discoveries	None
Basin Type	Passive margin, rifted subbasins
Depositional Setting	Fluvio-deltaic to marine
Reservoirs	?Cretaceous and Paleogene sandstones
Regional Structure	Extensional faulting, half-grabens
Seals	Marine shales
Source Rocks	Lower Cretaceous (gas prone) Upper Cretaceous, Paleocene marine shales (gas with some oil potential but barely mature)
Depth to Oil Window	3300-3800 m
Seismic Coverage	Sparse reconnaissance seismic
Area under Licence	None

Baffin Bay contains local depocentres with thick Mesozoic sedimentary sequences that have good potential for gas and oil. There is evidence of active oil seeps and petroleum source rocks. Cretaceous to Lower Tertiary formations are anticipated to have good reservoir characteristics. The basin is undrilled.

Geological Setting

Baffin Bay is the northwestern extension and terminus of the North Atlantic-Labrador Sea rift system. The progressive northward stepping of sea floor spreading in the North Atlantic resulted in graben development in the incipient Baffin Bay area in the Early Cretaceous. Oceanic crust began to form in Baffin Bay in the Paleocene but sea-floor spreading appears to have ceased in the Oligocene. Baffin Bay is bounded to the north by Nares Strait, a probable transform fault, and to the south by the Ungava transform underlying Davis Strait. Sedimentary strata are thickest along the narrow east Baffin shelf and the opposing and much broader west Greenland shelf. A major depocentre is present at the northern end of the Baffin shelf opposite the mouth of Lancaster Sound.

Sedimentation has been characterized by the influx of coarse elastic material across the rifted and rapidly foundering margin of Baffin Island. The sediments were derived from the surrounding highlands of the Baffin coast and by clastics brought from the lower Paleozoic hinterland of the Canadian Arctic Islands by major rift controlled drainage systems.

Exploration History

No wells have been drilled in Baffin Bay, with the exception of ODP site 645. In 1976-77, five wells were drilled in Davis Strait, at the southern entrance to Baffin Bay. These dry and abandoned wells are in Danish waters on the west Greenland Shelf. The Geological Survey of Greenland suggests that they failed to test prospective pre-Tertiary sequences indicated by seismic.

Seismic exploration of the northeastern Baffin shelf has been limited. The few reconnaissance programs shot are insufficient to delineate drilling prospects.

Stratigraphy (Fig. 66)

The Mesozoic sediments of Baffin Bay are probably underlain by Proterozoic rocks comparable to those now exposed on Baffin Island. Ordovician to Silurian rocks may be preserved in the offshore, but there is no seismic evidence to suggest that this is the case.

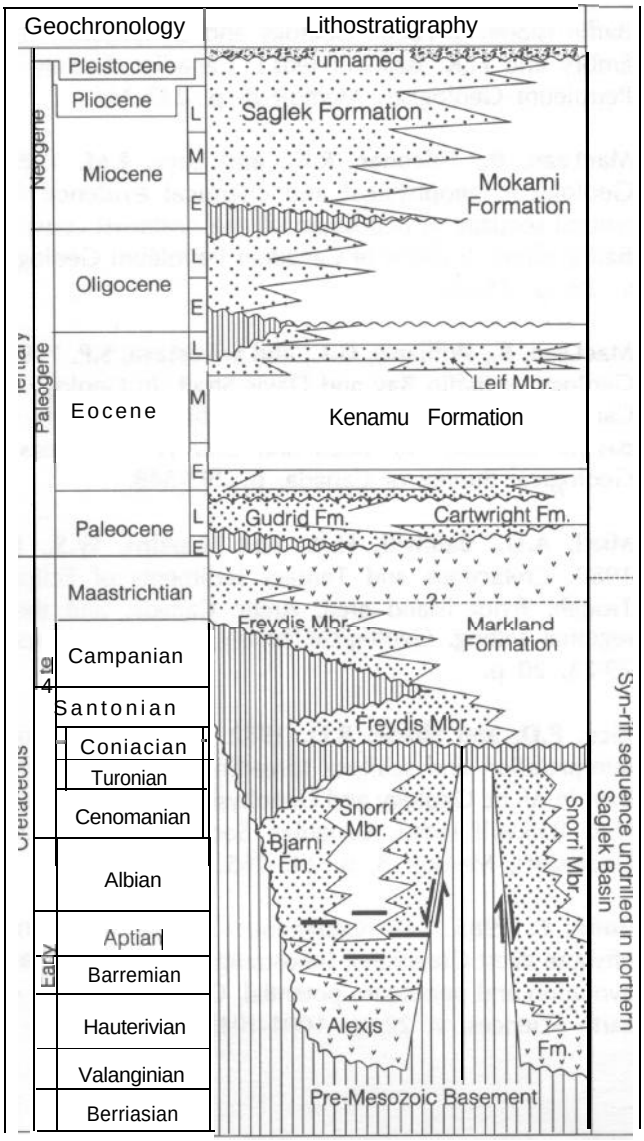

Figure 66. *Generalized stratigraphy of the Baffin Bay shelf area.*

The oldest Mesozoic sediments in the Baffin Bay region are Aptian to Lower Albian sandstones of the Quqaliut Formation, described by Burden and Languille (1990), north of Cape Dyer in the southern approaches to Baffin Bay. These strata are unconformably overlain by Paleocene braided stream deposits (Cape Searle Formation). The latter contains volcanic and volcaniclastic clasts formed during a violent tectonic episode, possibly the onset of sea-floor spreading in Baffin Bay. Cretaceous to Tertiary sediments also outcrop on Bylot Island and adjacent to Pond Inlet on northeastern Baffin Island. Strata of the Hassel Formation (Albian-Cenomanian), the Kanguk Formation (Campanian-Maastrictian), and the Eureka Sound Formation (Paleocene-Eocene) are likely to be represented as thickened successions in the offshore. The Hassel, Bjarni and Quqaliut formations are much the same age and represent early rift-fill. The Cape Searle, Eureka Sound and Cartwright formations are also contemporaneous, but differ markedly in their depositional setting.

The Hassel Formation on Bylot Island is predominantly fluvial, consisting of thick, coarse-grained sandstones and thin coals. The nonmarine fluviatile Quqaliut Formation was deposited in a similar depositional setting with intermittent volcanic effusions. The lower member of the younger Kanguk Formation (> 1000 m) was deposited at a time of global marine. highstand in the Late Cretaceous and represents a regionally extensive shale unit. The upper Kanguk is sandy and represents subsequent regression. The Eureka Sound Formation is 1600 m thick on Bylot Island and consists of three members of marine mudstone and sandstone and one thick member of fluvial sandstone. Lacustrine to marginal marine sediments of Paleogene age have been noted from two other localities along the east coast of Baffin Island.

Reservoirs

The Hassel Formation, upper Kanguk and Eureka Sound sandstones are potential reservoir rocks. All have good porosity and permeability in outcrop samples (in the Bylot Basin). Where age equivalents have been penetrated in the subsurface on the southeastern Baffin and Labrador shelves, favourable reservoir characteristics have been preserved.

Structure, Traps and Seal

Down-to-basin faulting characterizes the northeastern Baffin shelf. In the deeper parts of the basin, rotated fault blocks are apparent. The lower member of the Kanguk Formation is a regional top seal and drapes Cretaceous structures.

Source Rocks

Upper Cretaceous marine strata are widespread in the basin (the Kanguk and Narssamiut formations of the West Greenland shelf, although these shales are generally lean in organic matter). Samples of Campanian shale from Home Bay are rich in amorphous kerogens and these shales have potential as an oil-prone source rock. Paleocene marine shales have slightly higher organic content with potential for both oil and gas. Albian shales of the Hassel and Bjarni

formations contain terrestrially derived kerogens and are possible gas source rocks.

Subsea oil seeps in Scott and Buchan troughs (halfway along the coast of Baffin Island) are indicated by the surfacing of oil globules at several locations, as noted by several researchers (e.g., MacLean et al., 1981). The oil appears to issue from fissures close to the contact between the Tertiary or Cretaceous strata and Precambrian basement, although a more recent sampling expedition failed to recover samples of crude oil.

Potential

Most of the northeastern Baffin shelf is relatively narrow but thickens and broadens opposite the mouth of Lancaster Sound. This area is likely to contain extensive potential reservoir facies, more deeply buried (hence mature) source rocks, and large fault-bounded traps. Potential exists for both oil and gas.

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SAGLEK AND LADY FRANKLIN BASINS (SOUTHEASTERN BAFFIN SHELF)

Age	Cretaceous (Neocomian) to Tertiary
Depth to Target Zones	2.5-3.5 km
Maximum Basin Thickness	8 km
Sole Discovery	Hekja O-71 (gas/condensate)
Basin Type	Pull-apart near Atlantic-type passive margin transform
Depositional Setting	Fluvio-deltaic marine shelf
Reservoirs	Paleocene Hekja sand (middle Gudrid Member)
Regional Structure	Transpressional and transextensional faulting, horst and graben
Seals	Marine shales
Source Rocks	Upper Cretaceous, Paleocene marine shales (gas with some oil potential but barely mature)
Depth to Oil Window	3300 m (Hekja O-71)
Total Number of Wells	3
Seismic Coverage	Good reconnaissance seismic grid
Area under Licence	11,184 ha (Significant Discovery Licence at Hekja O-71)

(Water depths from 200-l 000 m, ice infested waters. Population and administrative centre at Iqualuit at head of Frobisher Bay on Baffin Island.)

Exploration has proved the Labrador Sea to be a rich hunting ground for large gas/condensate discoveries. Source rock studies also indicate potential for oil. Development is hampered by remoteness and severe ice conditions.

Geological Setting

The Saglek and Lady Franklin basins are Tertiary sedimentary depocentres lying within a zone of transform faults delimiting the northern end of the Labrador Sea. The basins are bounded to the northwest by the rising floor of Proterozoic rocks forming Baffin Island. Transtensional stress in the Late Cretaceous and Paleocene resulted in the effusion of large volumes of volcanic and igneous rocks and the development of horst and graben structures, subsequently filled and draped by late Paleocene and younger sediments. The provenance of coarse sediment lies to the west in the highlands of Baffin Island with fine grained input from a large river system draining the continental interior via the Hudson Strait.

Exploration History

Three wells have been drilled in Canadian waters offshore of southern Baffin Island: Aquitaine et al. Hekja O-71, Canterra et al. Raleigh N-l 7 and Esso HB Gjoa G-37. Five wells have been drilled in Danish waters on the Greenland side of Davis Strait, approximately 500 km to the northeast.

Seismic coverage of the Labrador and southeast Baffin shelves is good. A small number of regional lines traverse the Labrador Sea and connect with seismic shot on the west Greenland shelf.

Stratigraphy

A clastic wedge of Paleocene to Recent fluvio-deltaic and marine sandstones, interfingering with shales is up to 4000 m thick. It overlies Upper Cretaceous and Paleocene volcanic rocks above the rifted basin margin. Older rift sediments beneath the volcanic sequence have not been penetrated in the north Saglek Basin but may be present and should include the Bjarni sandstones preserved in rifted half-grabens.

Paleocene middle and upper Gudrid sandstones have been drilled in north Saglek Basin. These grade distally into lower and upper members of the Cartwright Formation (up to 1500 m). Marine shales and siltstones of the Eocene Kenamu Formation overlie and overstep the Cartwright Formation onto the basin margins. A major late Eocene unconformity truncates the Paleocene to Eocene succession over structural highs. Mokami (marine mudstones) and Saglek (predominantly sandstone) formations overlie this unconformity and constitute a lightly structured post-drift megasequence.

Reservoirs

The Hekja sandstone is a 76 m interval in the Hekja O-71 well. Net sandstone amounts to 44 m and consists of fine to coarse grained sandstone, varying from quartzose to arkosic. Although poorly sorted, feldspar dissolution has produced a reservoir rock with porosity of 16% and permeability of 10 mD. The environment of deposition is interpreted as lower delta-plain. Other Paleogene sandstones are present in this area and may show marked variation in thickness and reservoir characteristics. Very thick sandstone reservoirs are possible in this geological milieu marked by rapid input of coarse clastics and active vertical tectonics.

Structure, Traps and Seal

High-relief structures and complex depositional systems make prediction of potential reservoir sandstone difficult in this region. A variety of large structural traps are present in the Paleogene, including flower structures in regions of local transpression, and drape across fault-bounded blocks. Marine shale tongues form effective seals.

Source Rocks

Paleocene shales have total organic contents of l-2% in Hekja O-71. A 300 m zone has high resinite content (oil-prone at relatively low maturity levels) and a hydrogen index of 400. Older source rocks, which may underlie or inter-finger with the Upper Cretaceous and Paleocene volcanics, are likely to be gas-prone and mature. Sea-bed coring off Cumberland Sound has recovered samples of dark grey to black mudstone saturated with gas and condensate. Shallow seismic reflectors appear to be masked in this area, possibly by gas-saturated sediments (MacLean et al., 1982).

Potential

Although source rock studies indicate some shales to have potential as oil source rocks, exploration in the Labrador Sea has shown this basin to be gas/condensate prone. Numerous large structures and the potential for thick pay intervals make large discoveries possible. Syn-rift sediments, if present, are obscured by volcanics in the Saglek Basin: thick sandstones of the Bjarni Formation are rift-fill.

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PALEOZOIC BASINS OF THE ARCTIC PLATFORM (FOXE AND SOUTHAMPTON BASINS)

Age	Early Paleozoic over Precambrian; small area of Cretaceous in Southampton basin
Depth to Target Zones	<1000 m
Maximum Basin Thickness	1000 m in the Foxe Basin, increasing to 2000 m or more in the Southampton subbasin
First Discovery	None
Basin Type	Interior, local rifting
Depositional Setting	Marine shelf
Potential Reservoirs	?Cambrian-Ordovician sandstones, carbonates
Seals	Unknown
Source Rock	Ordovician oil shales
Depth of Oil Window	Unknown
Total Number of Wells	1: Aquitaine et al. Rowley N-14
Seismic Coverage	Very limited
Area	120,000 km^2
Area under Licence	None

The Foxe Basin is an extensive but shallow Paleozoic basin, deepening to the south into the Southampton subbasin, which contains Mesozoic strata. The Ordovician has the potential for oil source rocks and minor reef development. Potential for oil is low to moderate and large accumulations are unlikely. Exploitable accumulations of gas are very unlikely, given the lack of maturity, source rock, seal and significant reservoir pressure. The deeper Southampton subbasin has a somewhat higher potential.

Geological Setting (Fig. 67)

The Foxe Basin is the northern component of the Hudson Bay Platform, separated from the Hudson Bay Basin to the south by the Bell Arch. The basin extends onshore in southeastern Baffin Island where two parallel northwest-oriented rift systems are present. The northern rift is less developed and extends across Baffin Island into Cumberland Sound. The southern rift system flanks the Bell Arch and underlies Hudson Strait and Foxe Channel. The half-graben underlying the Foxe Channel within this rift system is called the Southampton subbasin.

Exploration History

The single exploration well in the Foxe Basin, Rowley N-14, drilled in 1971, terminated in Precambrian rocks at a depth of 512 m. The well penetrated Ordovician carbonates and Cambrian sandstones.

Stratigraphy (Figs. 68, 69)

Igneous/metamorphic basement rocks are overlain by the Cambrian clastic/carbonate succession comprising the Gallery and Turner Cliffs formations. These are

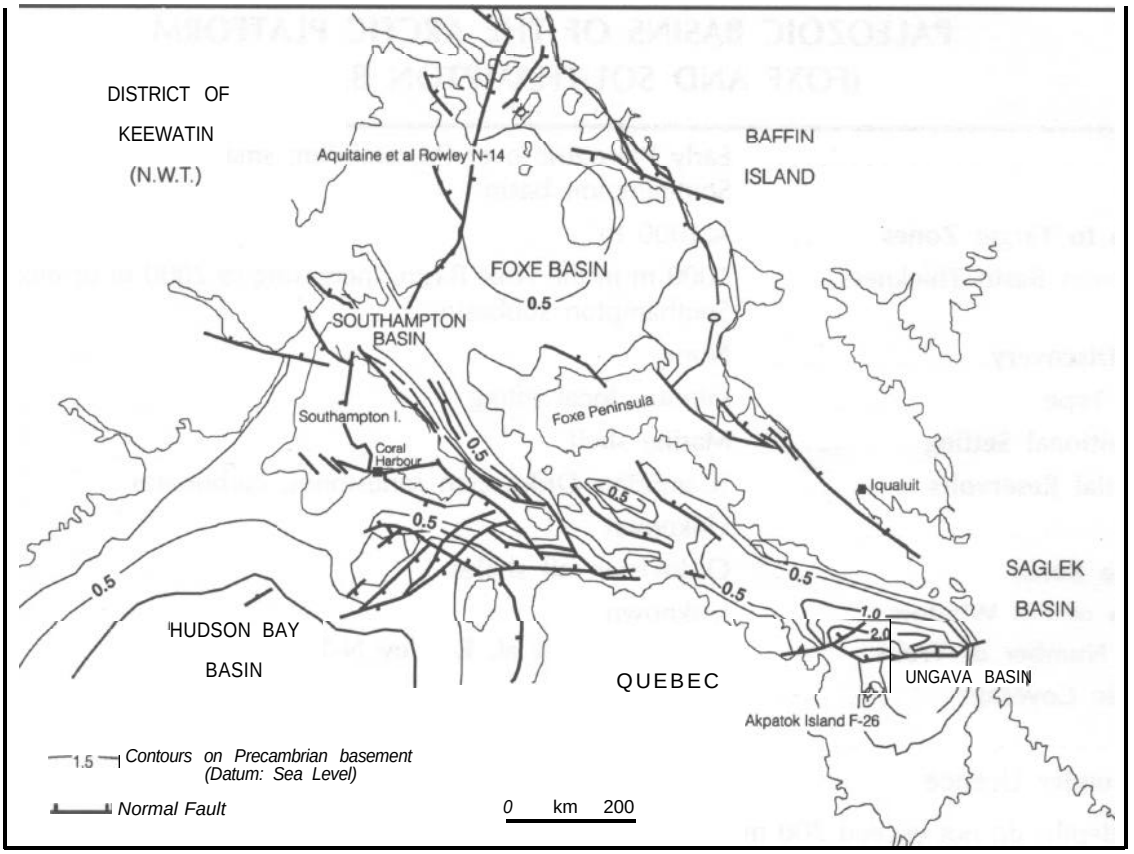

Figure 67. *Regional structure of the Foxe Basin and adjacent areas (contours in thousands of metres).*

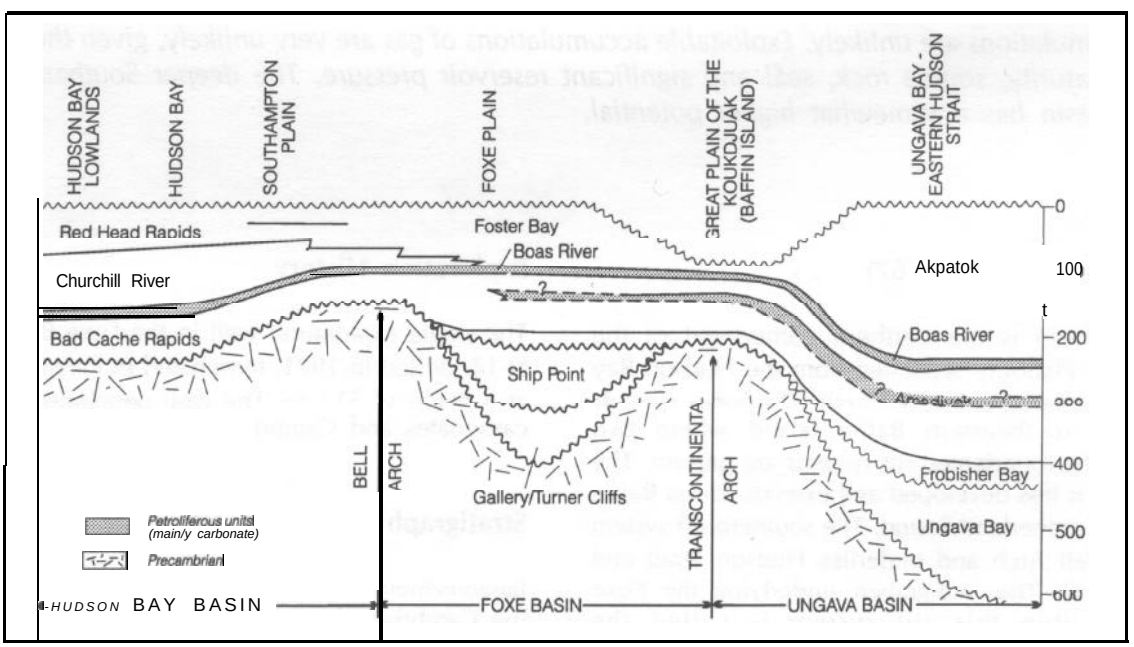

Figure 68. *Stratigraphic cross-section from the Hudson Bay lowlands northwards to Ungava Bay.*

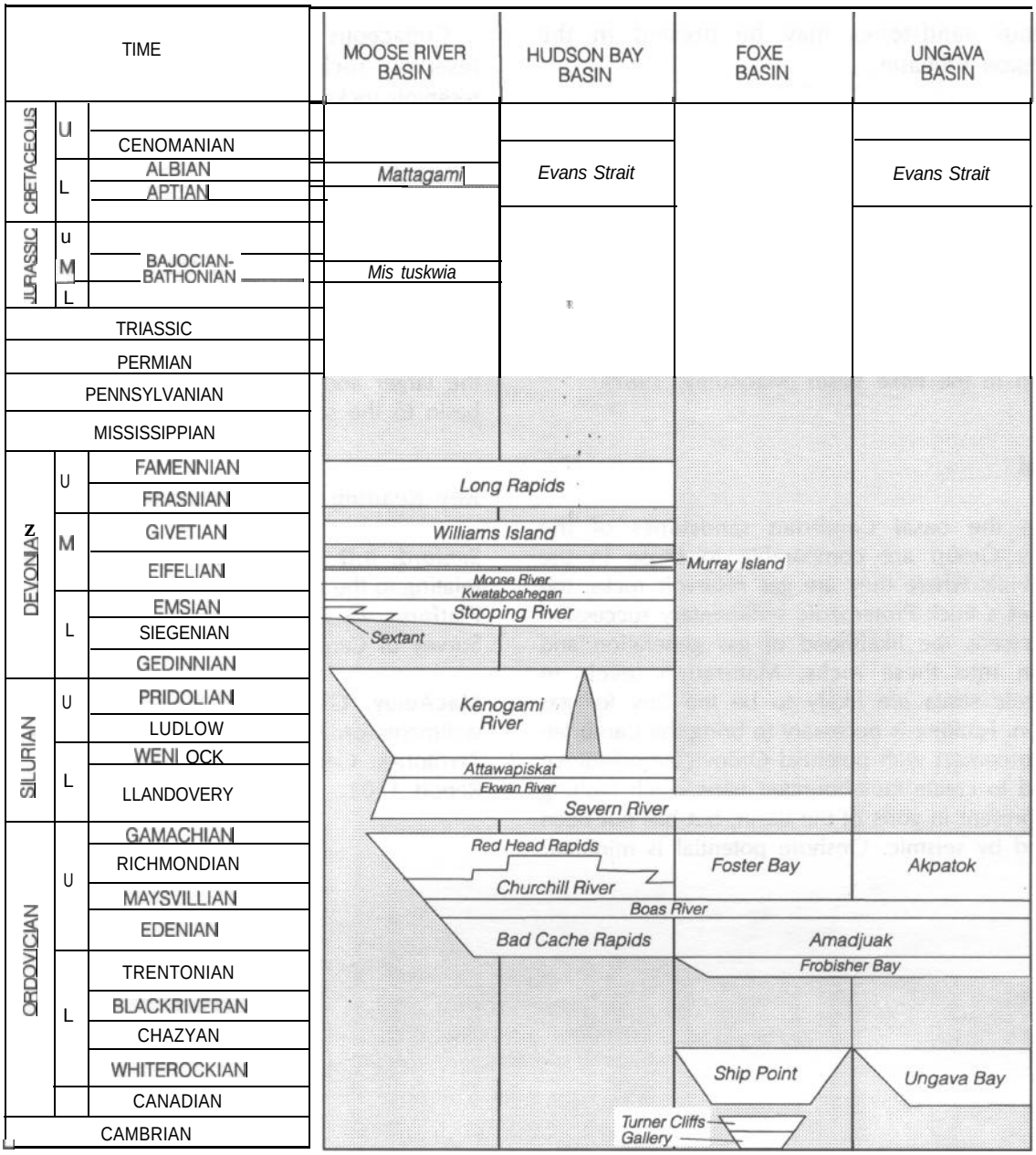

Figure 69. *Stratigraphic chart for the Moose River, Hudson Bay, Foxe and Ungava basins.*

overlain by the Lower Ordovician Ship Point Formation (dolostone with minor sandstone), some 80 m thick in the Rowley well. The upper Middle Ordovician to lowermost Silurian is represented in the basin by the Frobisher Bay, Amadjuak, Boas River, Foster Bay and Severn River formations – similar and probably depositionally contiguous with the equivalent succession in the Hudson Bay Basin. It is a predominantly carbonate succession.

Total thickness of the Phanerozoic succession in the Foxe Basin probably is in the order of 500 m except in the Southampton subbasin, where a thick wedge of Cretaceous strata is preserved. As much as 2000 m of Cretaceous strata may be present, informally designated the Evans Strait formation.

Reservoir Rocks

Cambrian sandstones of the Admiralty Group have good reservoir potential. Bioherms in the Ordovician carbonate succession are possible reservoirs but are likely to be small with poorly developed porosity.

Cretaceous sandstones may be present in the Southampton subbasin.

Source Rocks

Ordovician oil shales (principally the Boas River Formation), first described from Southampton Island, are now recognized as being widespread across the Hudson Platform. Exposures on southwestern Baffin Island confirm the presence of oil shows in the Amadjuak Formation and the overlying Boas River Formation in the Foxe Basin (MacAuley, 1987).

Potential

Although the basal Cambrian sandstones of the Admiralty Group are comparable to those in the Colville Hills where they are gas reservoir rocks, the absence of a thick Proterozoic sedimentary succession greatly lessens the likelihood of gas generation and migration into these rocks. Maturation levels in Phanerozoic strata are likely to be too low for gas generation. Faulting is necessary to bring the Cambrian strata into contact with potential Ordovician oil-source rocks and to create fault-bounded traps. Such faulting may be present in parts of the basin, but has not been delineated by seismic. Onshore potential is minimal.

Cretaceous strata may contain good potential reservoir rocks comparable to Lower Cretaceous reservoir rocks in the Labrador Sea basins. Subcrop of Ordovician oil source rocks beneath the Cretaceous creates an opportunity for basal Cretaceous stratigraphic traps. Cretaceous potential is wholly offshore and restricted to the Southampton subbasin.

Potential across most of the Foxe Basin is low due to the thin sedimentary succession. In the deeper Southampton subbasin, potential is moderate. Further exploration likely awaits significant encouragement in the larger and geologically comparable Hudson Bay basin to the south.

Key Reading and References

Sanford, B.D. and Grant, A.C. 1990. New findings relating to the stratigraphy and structure of the Hudson Platform. Current Research, Part D, Geological Survey of Canada, Paper 90-l D, p. 17-30.

MacAuley, G. 1987. Geochemistry of organic-rich sediments on Akpattok and Baffin islands, Northwest Territories. Geological Survey of Canada, Open File Report 1502.