The Arctic Island Adventure and Panarctic Oils Ltd

SNAME Arctic April 21, 2010

Calgary, Alberta

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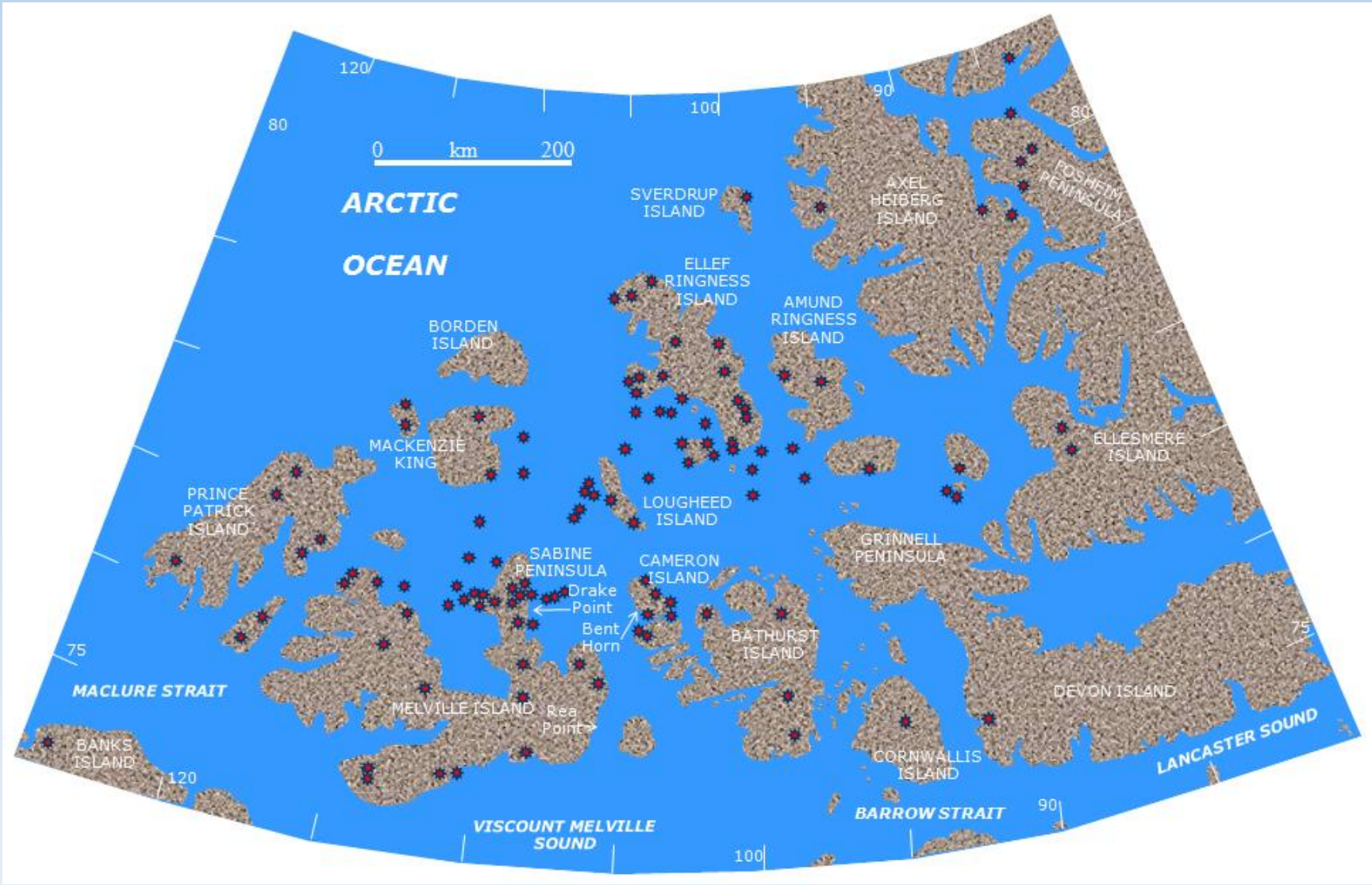
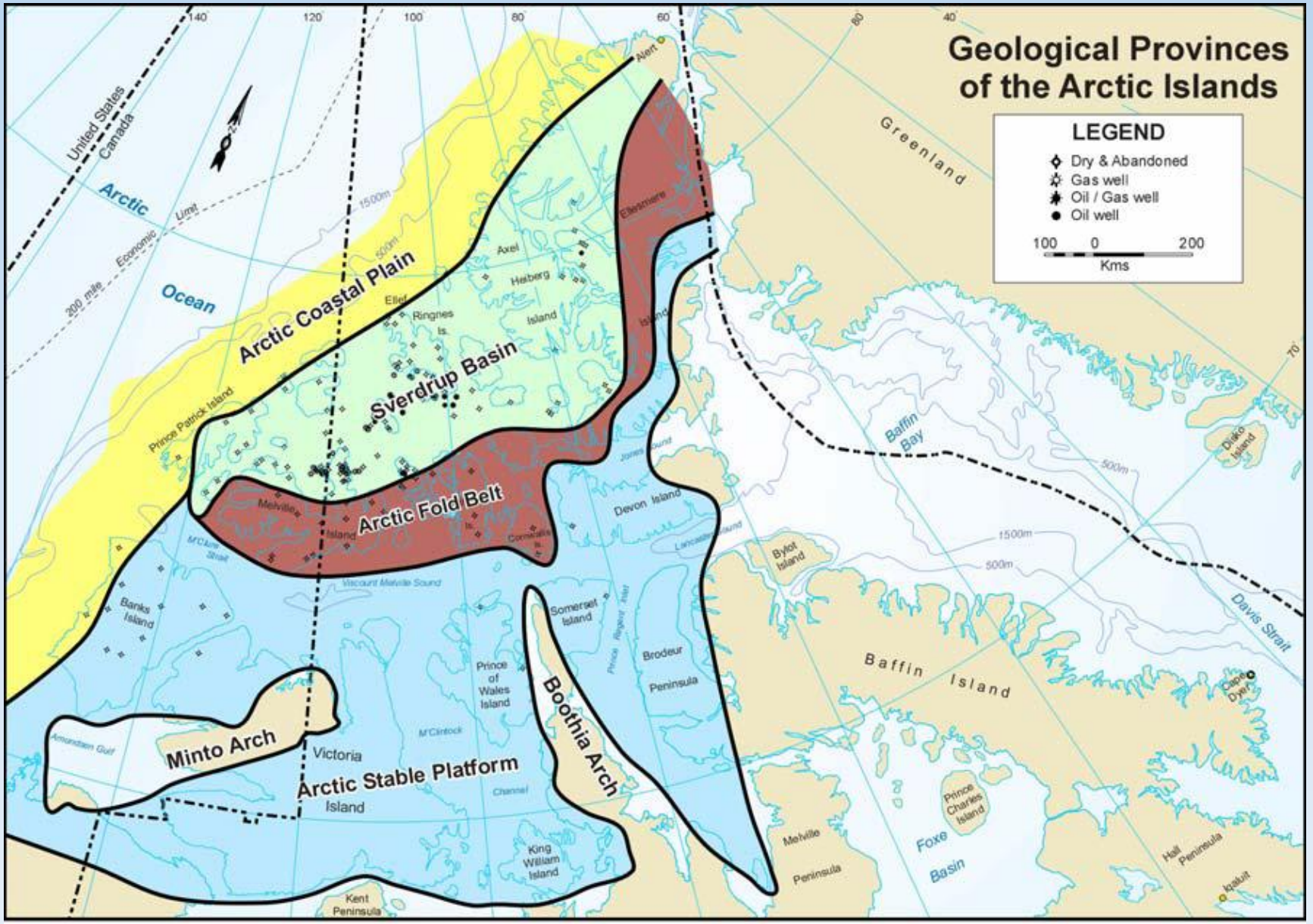
The Society of Naval Architects & Marine Engineers
Arctic Section

Arctic Island Wells





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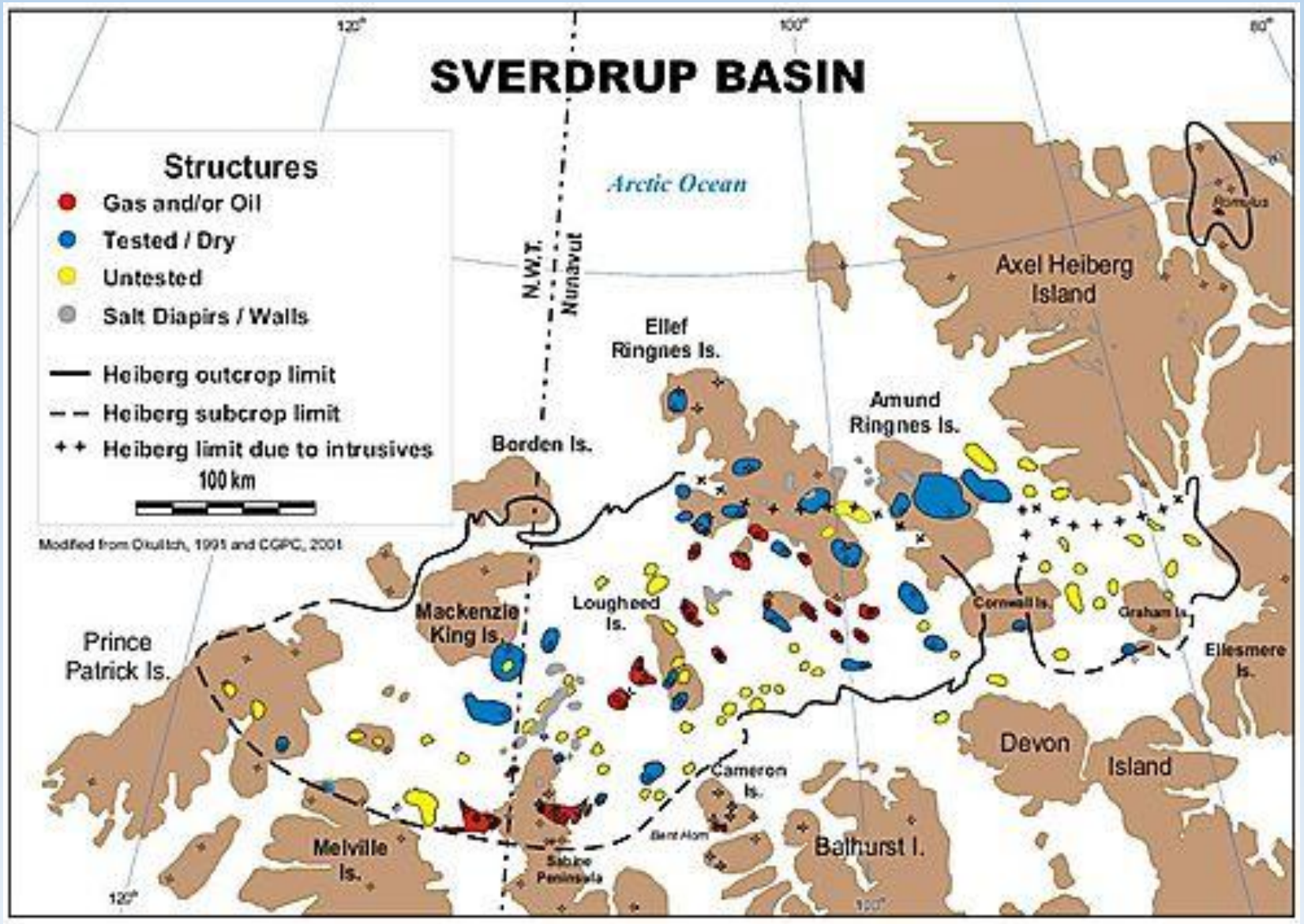
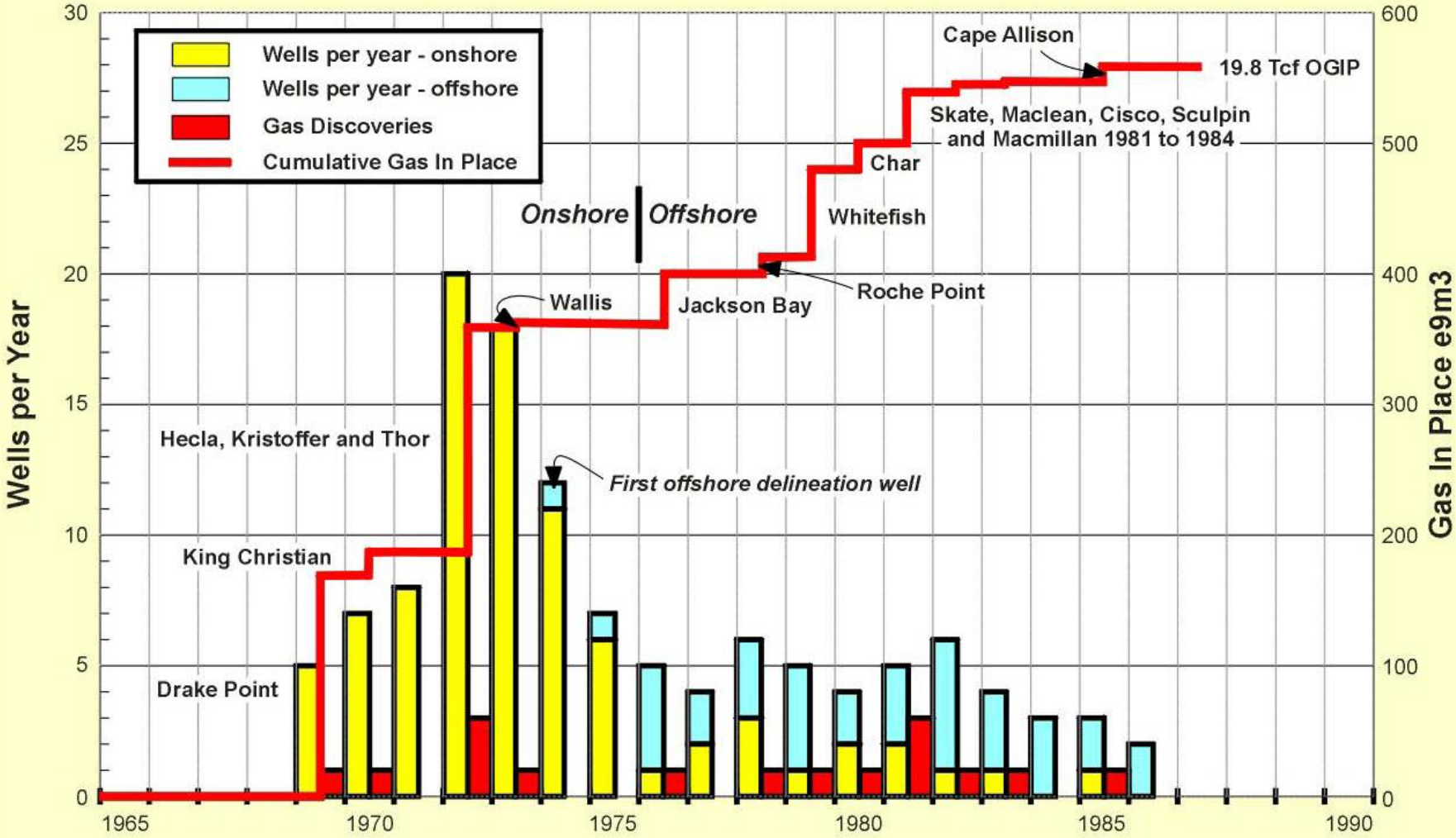
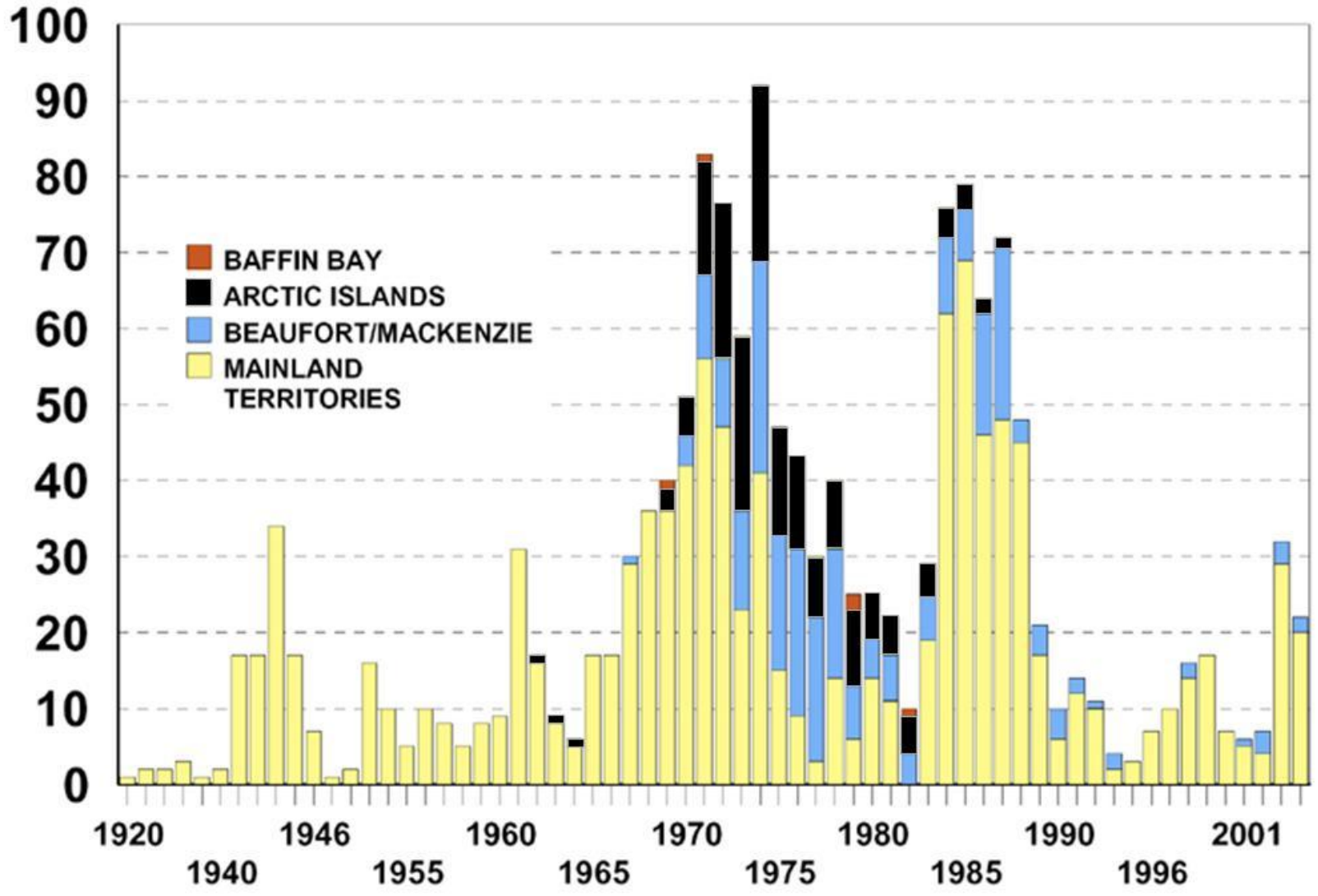

SVERDRUP BASIN
Structures
Gas and/or Oil
Tested / Dry
Untested
Salt Diapirs / Walls
Heiberg outcrop limit
Heiberg subcrop limit
Heiberg limit due to intrusives
100 km
Modified from Okulitch, 1991 and CGPC, 2001
Arctic Ocean
N.W.T.
Nunavut
Axel Heiberg Island
Ellef Ringnes Is.
Amund Ringnes Is.
Borden Is.
Prince Patrick Is.
Mackenzie King Is.
Lougheed Is.
Cornwallis Is.
Graham Is.
Ellesmere Is.
Devon Island
Cameron Is.
Melville Is.
Sabine Peninsula
Bent Horn
Balhurst I.

SVERDRUP BASIN
DRILLING AND DISCOVERY HISTORY



NORTHERN CANADA - TOTAL WELLS DRILLED



Background

- Panarctic was incorporated May 27, 1966 by Federal Letters Patent
- Operations started in 1968 with first seismic
- Industry/government consortium to explore for oil and gas in the Canadian Arctic Islands
- Up to 37 companies participated
- With the formation of Petro-Canada, it over time assumed controlling interest

Background

- Panarctic drilled 150 wells over an area measuring some 850 by 1200 km
- The most northerly well located approximately 80°45’ N on Ellesmere Island and the most southerly well at 72°40′ N on Prince of Wales Island
- The first exploratory well was drilled by Panarctic in 1969 with a drilling rig flown from Yellowknife

Exploration and drilling

- Panarctic drilled 112 onshore wells, using conventional land rigs
- Transportation either by aircraft or overland by vehicles such as trucks and/or tracked or rubber tired all terrain vehicles
- Panarctic has also drilled 38 offshore wells using modified land rigs.
- The rigs were supported by ice platforms constructed with thickened sea ice.
- These wells were drilled in water depths ranging from 55 m to 550 m.

Costs

- Well costs were relatively low for a frontier area.
- An onshore well could be drilled to a depth of 3000 m for $11-12 million
- An offshore well of similar depth could be drilled for $22-23 million
- In the early days (1969 to mid 1970's) wells were drilled for $2 to $4 million

Other operators

- Some additional 37 wells were drilled by other operators in the Arctic Islands
- The first well drilled in the Arctic Archipelago, Dome et al Winter Harbour #1 was drilled in the winter of 1961-62 to 3,828 metres using a rig which was transported by ship
- 14 years later Panarctic was contracted to dispose of the rig as it had been abandoned at the well bore

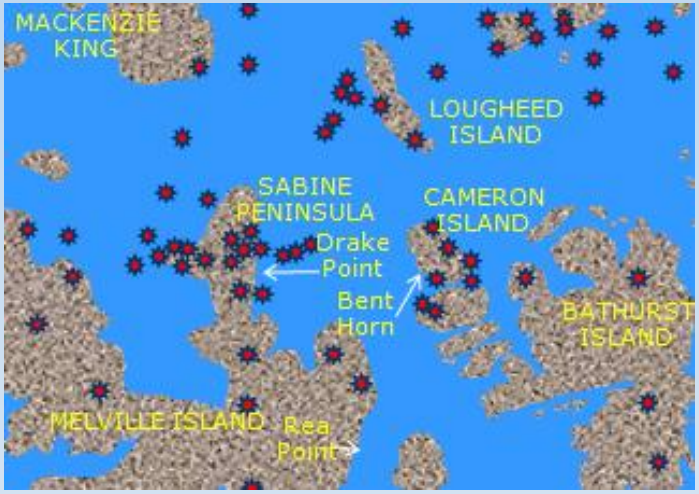
Sherard Bay Camp

Radio Shack and Cookhouse

Tracked camp with Big Indian Drilling Rig 3. On Ellef Ringnes Island near Kristoffer Bay.
We were drilling shallow holes to determine the depth of the permafrost - varied 700 feet to 1300 feet.

SUPPLY BASE - REA POINT

- Deep water at the shoreline eliminated the need for costly wharves or docks
- The flat terrain with sandy soil provided room for a year-round airstrip plus a materials storage area
- Soil conditions allowed vehicle movement in the summer as well as the winter
- The airstrip was built up and topped with a shale/ gravel mixture from local stream beds and some clay and drainage was improved
- A 120 man camp, warehouse, maintenance shop, hanger, and fuel storage facilities were situated at Rea Point



Rea Point base camp

I'm sure I parked my truck around here somewhere!
It seems we had a bit of a storm yesterday.

Sealift

- The majority of the equipment, including drilling rigs, supplies, and fuel required to drill wells at remote sites in the islands, was sealifted into Rea Point annually
- A short two week window in late August/early September provided open water or pack ice conditions
- Ocean-going freighters and tankers with Lloyds 100 A-I ice class hulls normally were loaded in Montreal and traveled to Rea Point via the east coast of Labrador and Baffin Island, Lancaster Sound, Barrow Strait and Byam Channel
- The ships were usually escorted by a Canadian Coast Guard ice breaker
- The freighters were commonly in the 1750 to 8000 tonne range and the tankers in the 16,000 to 36,000 tonne range

Sealift

- At Rea Point, the freighters were positioned parallel to the beach, approximately 10 m offshore and tied off
- A small barge was placed between the ship and shoreline and earth ramps were pushed up to the barge
- Unloading then proceeded using the ship’s cranes and forklifts
- For fuel transfer, the tanker normally nosed in to the beach and maintained its position with thrusters or main propulsion
- Floating hoses were pulled out to the tanker from shore and the ship's pumps were used to pump the fuel 2.75 km , through a 254 mm pipeline, to steel tanks near the camp

Sealift Volumes

Year	Total Dry Cargo Tonnes	Total Fuel Litres x 10^6	Number of Wells Drilled
1980	4,934	15.31	5
1981	5,832	16.36	5
1982	10,131	7.85	5
1983	3,403	16.21	4
1984	1,110	9.59	4
1985	1,036	12.15	3

- When a new rig was not required until the following January or February to drill an offshore well , the high cost components which were commonly the high weight/low bulk items, were trucked from Edmonton to Hay River or Yellowknife and flown by Hercules directly to the wellsites.

Onshore Wells

- Normally wells were drilled in the fall since the cost of an onshore well might increase by $0.8 to $1.0 million or 7% to 8% of its total cost if it were drilled over the summer
- The well location was surveyed, staked and the site visually marked with several drums
- Then construction equipment and an advance camp were brought in
- This was done by Cat train if the equipment was located on the same island and distances were under 200 km

Airstrip Preparation

- A crew then prepared a 400 m long x 25 m wide Twin Otter airstrip as close as possible to the wellsite
- A Hercules airstrip was, where possible, an extension of the Twin Otter airstrip and had the dimensions of 60 m wide x 1800 m long
- The airstrip was normally bulldozed free of deep snow with the crawler type dozers and levelled as much as possib1e
- 20-40 mm of snow left on the strip surface filled small depressions when the strip was dragged or graded
- Soil disturbance was kept to a minimum for environmental reasons and also for practical reasons

The Sikorsky S-61

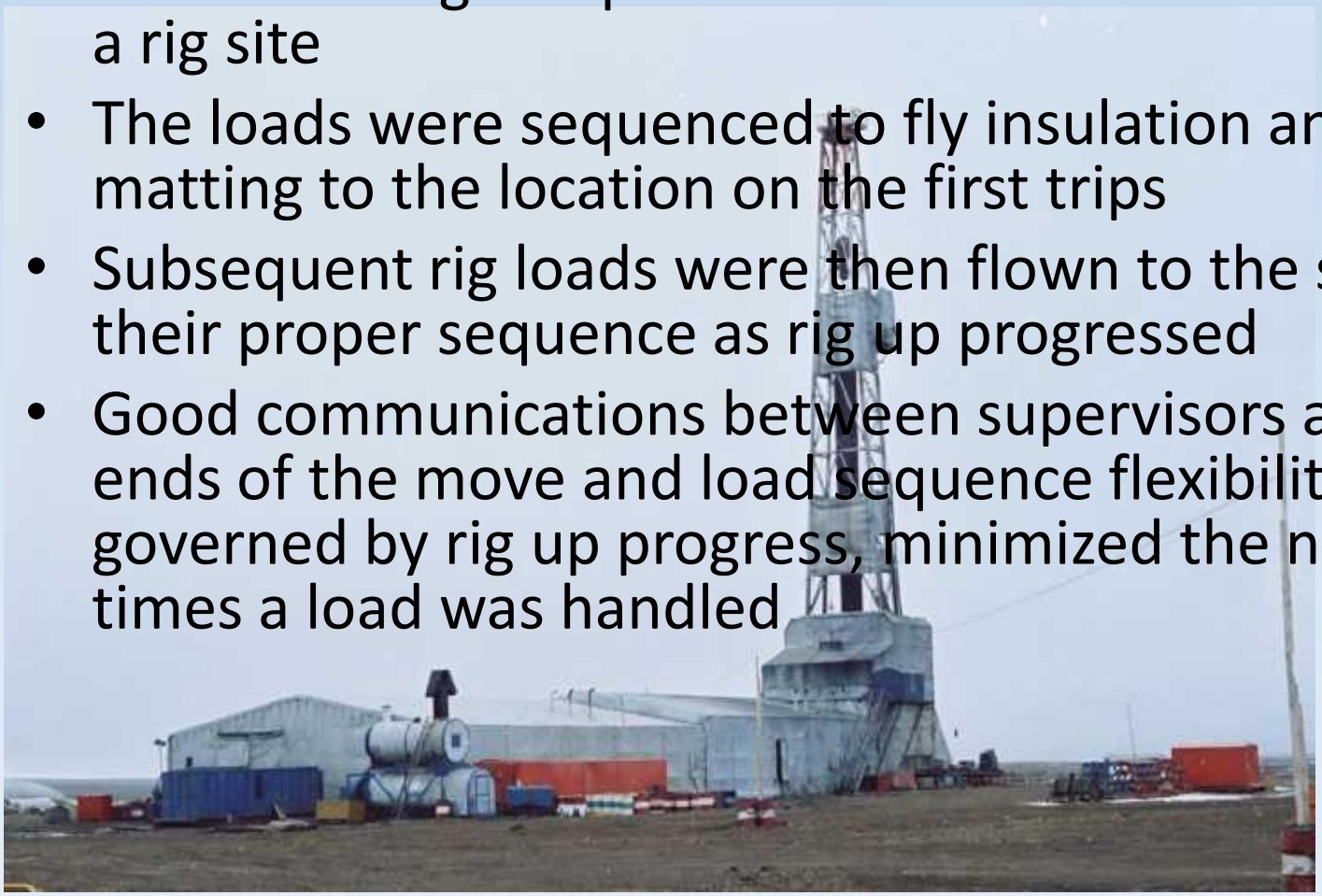
Onshore Wells


Delta Commander

- Subsequent trips with the Hercules brought in
  - a 20-30 man advance camp
  - larger generators
  - incinerator
  - aircraft refueling unit
  - bladder type fuel storage tanks
- Trucks and heavy equipment were flown in to construct a pad for the drilling rig
- A small self-propelled drilling rig and 25-50,000 kg of explosives were flown in to construct a mud disposal sump for the drilling operation

Onshore Rig Move

- An 80 man rig camp was the first item to be flown in to a rig site
- The loads were sequenced to fly insulation and rig matting to the location on the first trips
- Subsequent rig loads were then flown to the site in their proper sequence as rig up progressed
- Good communications between supervisors at both ends of the move and load sequence flexibility, governed by rig up progress, minimized the number of times a load was handled



Adeco Drilling Rig #4 on Dundas Peninsula on Melville Island.

Onshore Rig Move

- Two special pieces of equipment were required
  - A 25 metric tonne crane scale to weigh all loads before transport by the Hercules
  - a specially designed tandem low bed truck trailer with an overall width of 2.7 m and a deck approximately 1 m above ground level when loaded

Item		Loads
1)	Advance Camp	6
2)	Construction Equipment	25
3)	Rig Camp	20
4)	Drilling Rig	82
5)	Mud, cement, Casing (incl. contingency)	30
6)	Fuel - 2.05 x 106 Litres	90
	Total Loads	253

Onshore Rig Move

- Fuel was flown from Rea Point by Hercules and stored in collapsible rubber tanks or bladders
- A rig move normally took 12-25 days, depending on weather conditions and Hercules serviceability
- Delays due to fog and blowing snow were common
- Despite the extremely cold ambient temperatures , aircraft downtime for maintenance was minimal
- A Hercules rig move would add $1.5 - $1.8 million to the cost of a well

Loading a Hercules

Fuel storage bladders

King Christian Island, July 1974

Latitude: 77.45.9 N
Longitude: 101.02.1 W

Gustavson Arctic Drilling - Rig 17

Air Support

- Initially supplies such as fuel, food, repair parts and small equipment were flown into the wellsite from Rea Point by Twin Otter
- Crew changes were effected weekly by air and consisted of 25-35 people from each rig plus other personnel
- When the airstrip was approved for the 727/737 jet aircraft, crew and supplies were flown directly to the wellsite from Edmonton

727/737 Flight Summary

		Northbound	Southbound		Northbound	Southbound
Year	Number of Flights	Freight (tonnes)	Freight (tonnes)		Number of Passengers	Number of Passengers
1980	117	938	458		4972	4902
1981	139	1335	505		6108	6079
1982	144	1282	519		6151	6089
1983	119	949	506		5136	4981
1984	88	728	330		3605	3579
1985	71	613	229		3007	2837

One of two Lockheed electra aircraft owned by Panarctic. Taking off from a sand strip at Sherard Bay on Sabine Peninsula, Melville Island.

Digging a Pit in Permafrost

A rough road

Burning garbage
Garbage was always burnt in a big pit.

King Christian Island

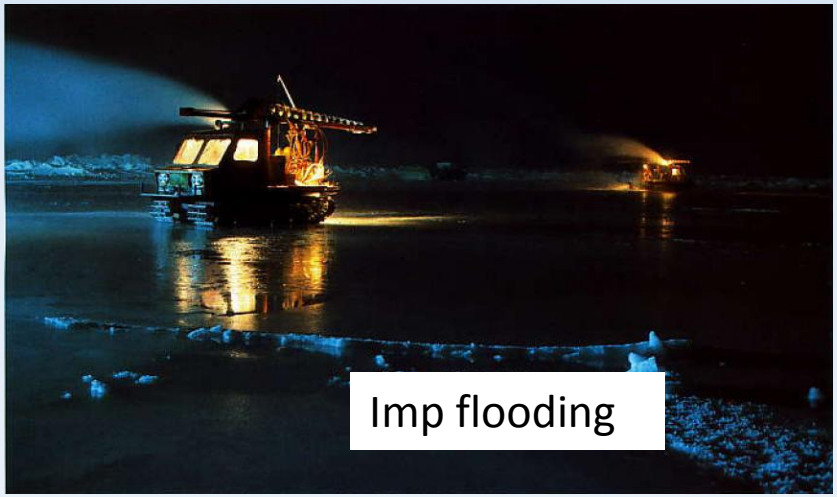
Getting it Wrong

OFFSHORE WELLS

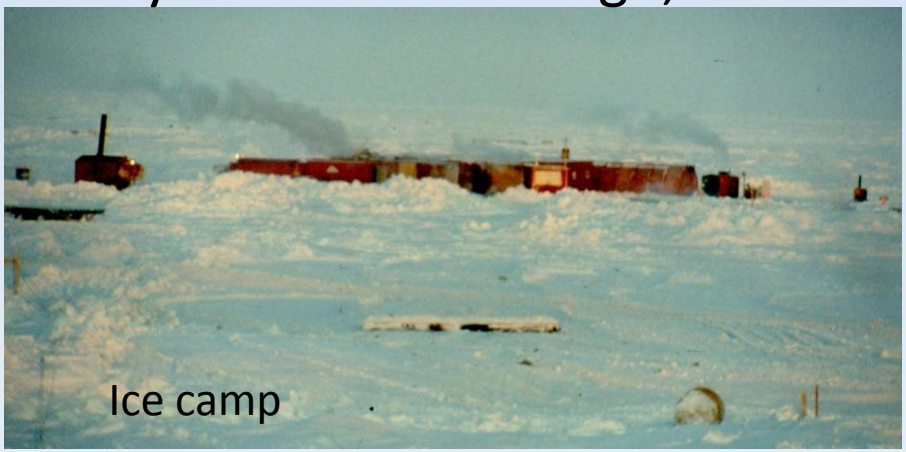
- Offshore well locations were selected from seismic work conducted from the ice in late winter. In the following year, the proposed well location was surveyed when stable ice occurred in late October/early November.
- The wellsite was staked and a site for a future Hercules airstrip was selected
- Preference was for smooth multi-year ice, but smooth first year ice was also suitable. Very rough multi-year ice could be used, however, the extra time required to level the ice surface made this the least desired choice

Airstrip Construction

- A helicopter transportable 20 man construction camp and equipment was flown from a land based staging area. The camp could be set up on a minimum of 1.0 m of sea ice. Some flooding might be necessary to build up or level the ice under the camp.
- Small tracked vehicles equipped with hydraulic ice drills and hydraulic driven flood pumps, small bulldozers equipped with rippers, forklifts, and tracked vehicles were delivered to the site using an S-61 helicopter.
- A Twin Otter airstrip was constructed as soon as possible after the camp was in place, either on level first year ice or on rough, hummocked multi-year ice.



Imp flooding



Ice camp

Airstrip and Ice Platform

- Flooding of the rig ice platforms proceeded immediately
- Simultaneously the Twin Otter airstrip was extended to a Hercules airstrip. On first year ice, where only flooding was required, build-up rates averaged 30 mm per day
- The final ice thickness was determined by criteria set out in the Ministry of Transport Specification
- For Hercules L-100-30 and Boeing 737 aircraft the required ice thickness was 1.37 m (54 inches)

Rig Mobilization and Storage

- The same procedures and equipment for land drilling was used for moving the rig to the ice platform.
- Once at site, the loads had to be stored on the surrounding ice with proper spacing to ensure that overstressing of the ice did not occur
- This was also true for the fuel storage in the rubber bladders
- The area around the fuel storage was kept clean of snow to enable spotting of any leaks

Rig Design

- The original rigs which were sent to the Arctic were an adaptation of conventional rigs designed for southern Canada oilfields
- Rig up was slow and transportation was inefficient
- Drifting snow accumulated on the open loads increasing their weight

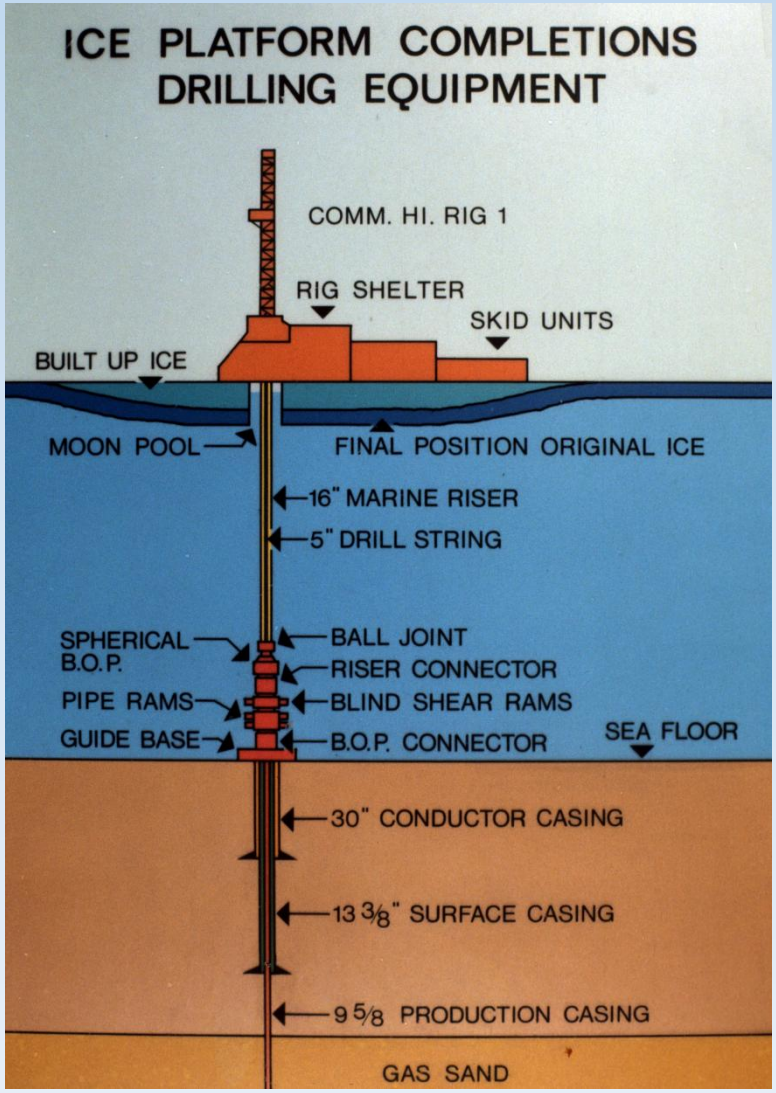
Rig Design

- A modular design was adopted
- A large number of components or combination of components was installed in totally enclosed Hercules sized modules
- They could be heated immediately after being positioned in the rig complex and could be stored indefinitely without accumulating snow after the rig is dismantled
- On a typical Arctic rig, 34 of the 82 rig loads were totally enclosed modules
- The rig matting used under arctic rigs was designed for Hercules aircraft and was used as skids to transport miscellaneous rig components which could not be incorporated into modules

Ice Platform Drilling

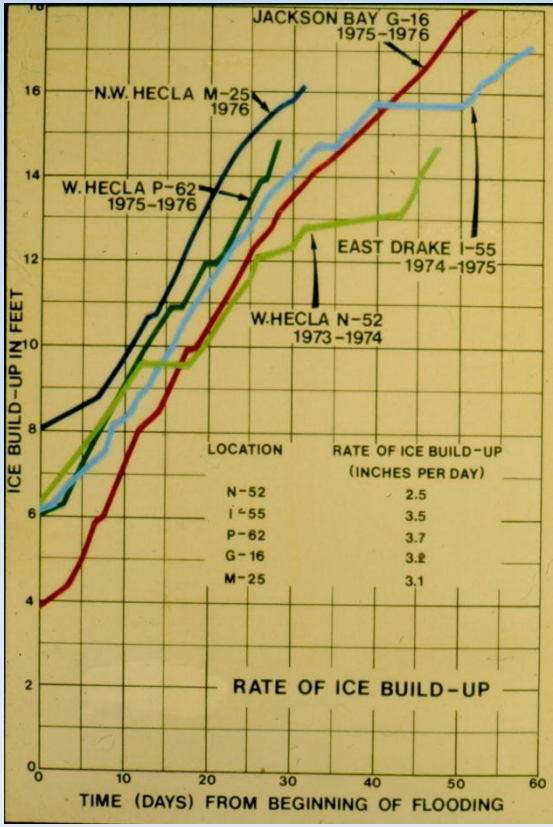
- 38 wells were drilled from floating ice platforms between 1974 and 1986
- This method of drilling was much cheaper than any competitive offshore drilling method
- All planned wells were drilled, logged and tested successfully
- Lateral ice motion during drilling had to be 5 % of water depth or less
- Ice motion was continuously measured and reported, cf. Alex Hittel presentation to SNAME
- Conventional land drilling rigs weighing up to 1200 tonnes were used to drill the wells
- Well duration, including rig-up, drilling, logging and testing, was limited to about 90 days to meet same season relief well capability which was a regulatory requirement
- This requirement is presently being reviewed

Ice platform drilling



Ice Platform Drilling

- Thickening of the natural ice was accomplished initially by flooding using electrical submersible pumps mounted in insulated wells
- Average ice build-up rates of 80 to 95 mm per day were achieved
- Later, spraying with high pressure pumps – 1400 kPa (200 psi) – was introduced
- This increased the build-up rate, nearly doubling it to 136 mm per day
- There was some compromise in strength of the ice but there was a net gain in drilling time of a week to 10 days.



Flooding an ice platform

Flooding an airstrip with hydraulic pump

Ice Platform Drilling – Q.A.

- A program of Q.A. and monitoring during construction and drilling was rigorously followed
- During construction the following were monitored
  - ice build-up
  - pumping hours and rates
  - total platform thickness
  - ice temperature and strength
  - weather information
- Daily reports with all collected data were radioed to Rea Point and then faxed south
- Personnel on site conducting the monitoring were also responsible for operating the pumps

Ice Platform Drilling - Monitoring

- During drilling and testing of the well, monitoring continued
  - vertical deflection of the ice under at the rig and along a profile of stations away from the load
  - the rate of vertical deflection with time had to be constant or decreasing and the total deflection had to be less than the total freeboard of the ice platform
  - ice temperature and properties
  - watching for drilling procedures which would compromise the integrity of the ice platform
- Sometimes warm waste water was improperly disposed of near the moonpool, endangering the foundation of the main rig substructure
- The moonpool itself was a wooden cribbing with insulation to minimize heating/melting of the ice
- Fresh, cold sea water was circulated in the moonpool and heat removal from the ice was effected using coiled tubing and a heat exchanger

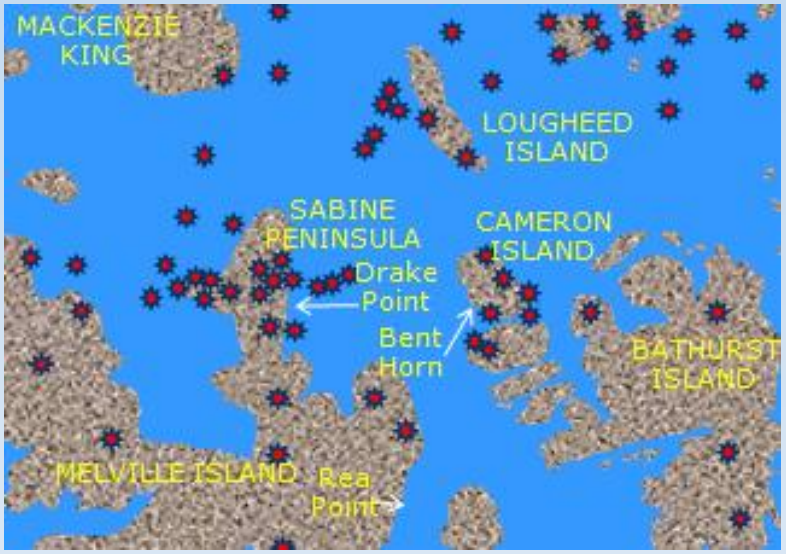
Panarctic rig on ice platform

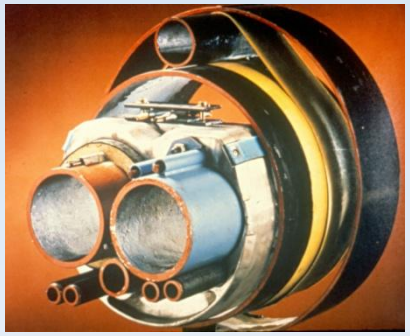
Panarctic Char 1980

A seal visits the tide shack

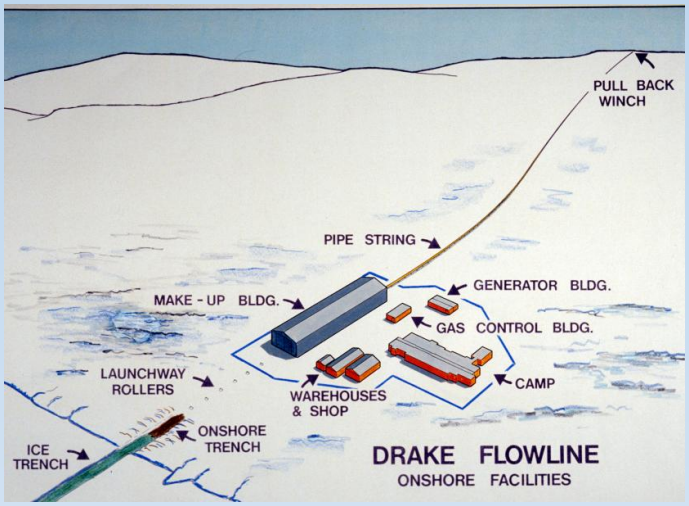
Drake F-76 Overview

- 1200 m offshore in 55 m of water
- Conventional Arctic Island offshore drilling using a Hercules transportable rig founded on a floating ice platform
- Two 152 mm flowlines, both heat traced, one insulated and one not insulated in a bundle
- Max flow of 20 m^3/s at 10 MPa pressure





Drake F-76 Production Gas Pipeline



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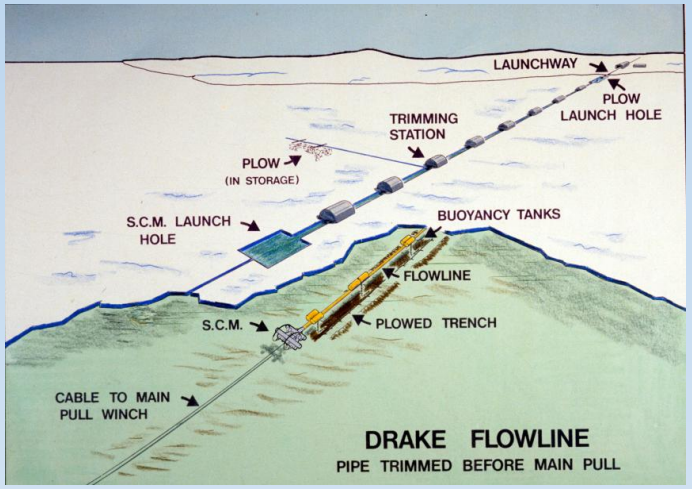

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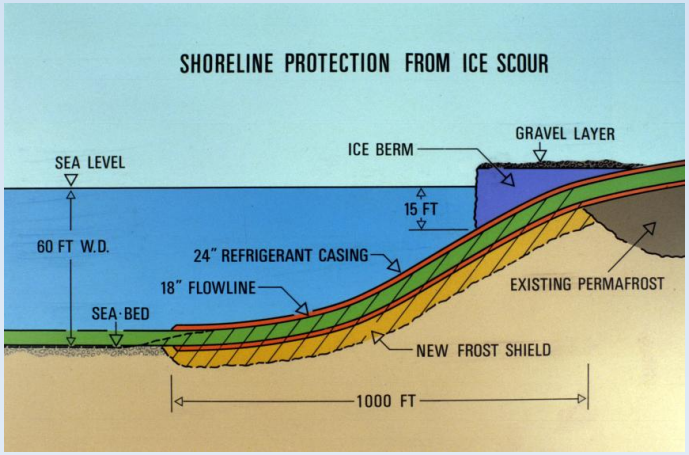

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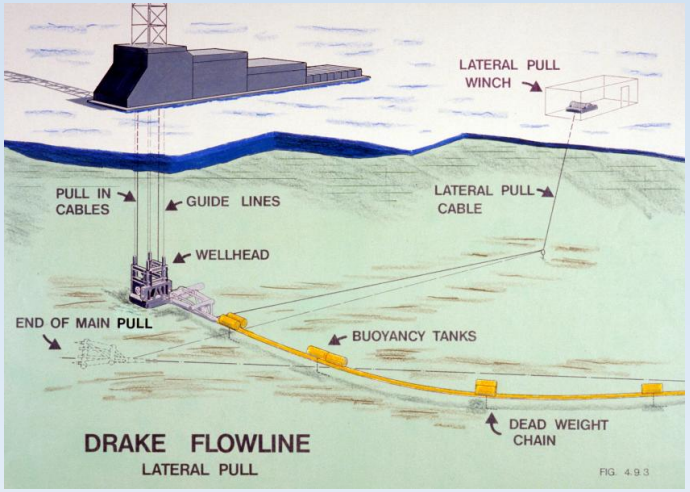

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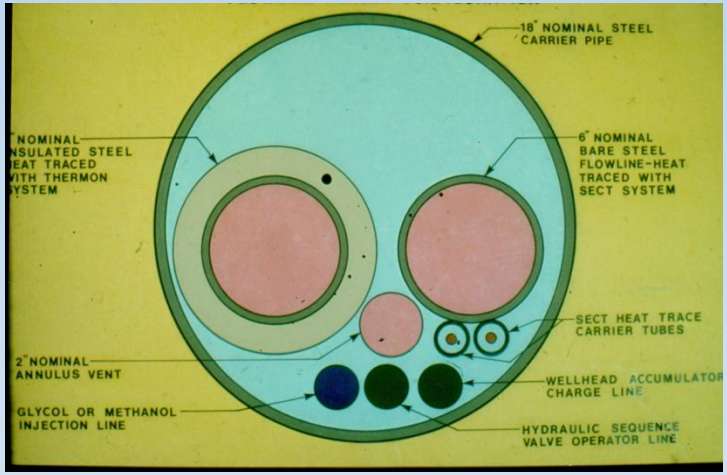
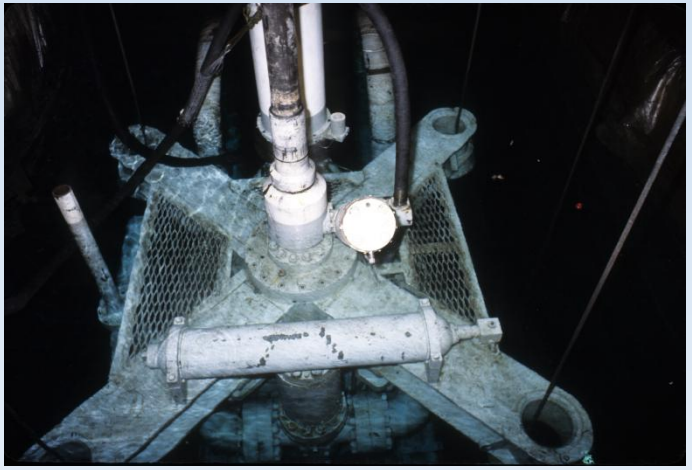
Drake flowline and wellhead



Pipe Bundle

Removing ice blocks

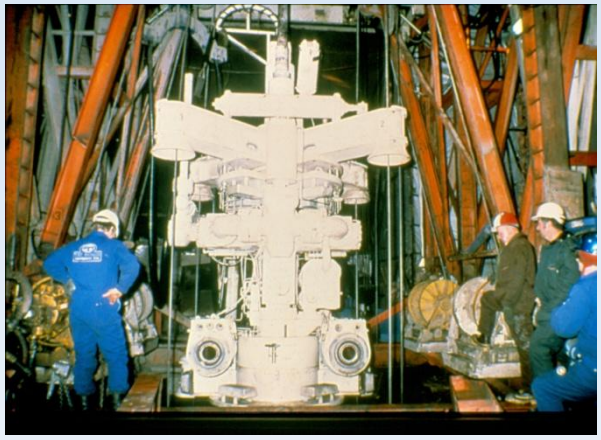
Laying pipe through ice trench



Lowering wellhead

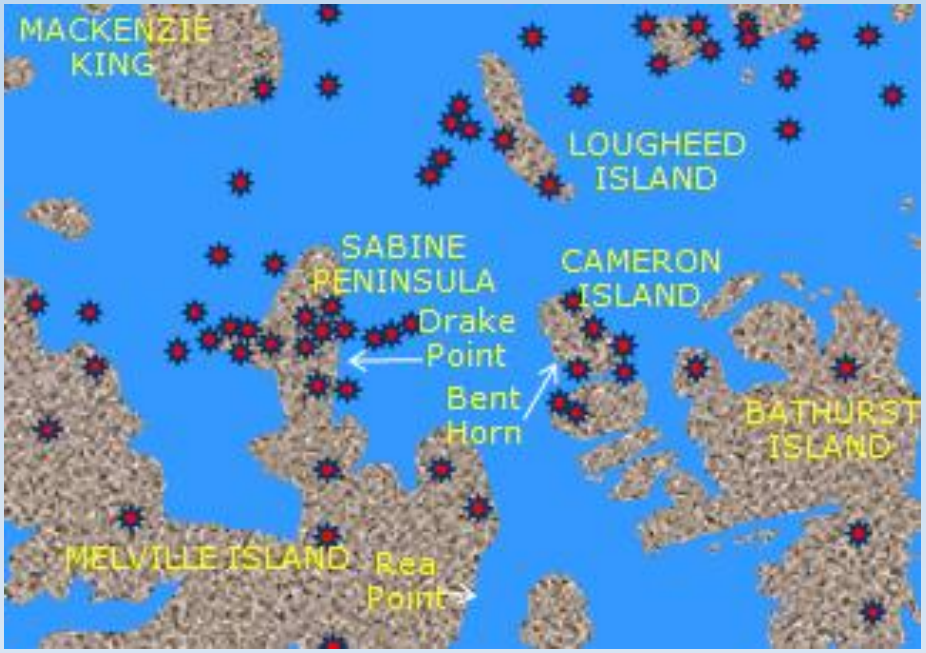
Drake F-76 Flow Test

- After rig release April 28, 1978 further tests were performed to determine
  - hydrate formation characteristics
  - performance of the insulated and un-insulated lines
  - experiment with alcohol injection rates and locations
- The extended production test was terminated May 14, 1978
- The well was placed on a continuous low production rate to provide fuel for the test facility and camp
- The well was shut in on November 28, 1978 after seven months of operation
- In 1995 the well was plugged and abandoned



Bent Horn Oil Production

- Bent Horn Oil: Early in 1974 Panarctic discovered the Bent Horn oil field on Cameron Island
- In 1985 the first shipment of 100,000 barrels was made by an ice-breaking tanker to a refinery in Montreal
- These shipments continued until the late 1990s



- The Bent Horn field is small – 12 million barrels of oil – compared to the largest yet found Cisco, near Lougheed Island, which has an estimated 584 million barrels of oil.

Ship loading at Bent Horn from storage tank

Thank you

Questions??