Petroleum Exploration Onshore Svalbard: A Historical Perspective on the Start of the Norwegian Oil Adventure*

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Search and Discovery Article #70406 (2020)**
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Abstract

Norway is a major petroleum exporting country, and revenues from the petroleum sector represent a major part of the state budget. The Norwegian petroleum industry is centered on the prolific fields of the North Sea (production started in 1971), the Norwegian Sea (production started in 1993) and large potential in the frontier Barents Sea (production started in 2007). The beginning of the Norwegian oil industry is often attributed to the discovery of the supergiant Groningen Field onshore Netherlands in 1959. This was followed by the first exploration drilling in the North Sea in 1966, the first discovery in 1967 and the discovery of the supergiant Ekofisk Field in 1969. However, petroleum exploration started onshore Svalbard in 1960 with three mapping groups from California Asiatic Oil Company and Texaco Overseas Petroleum Company (Caltex). In addition to the American companies, there were also exploration efforts by Dutch company Bataaffse (Shell) and Norwegian company Norsk Polar Navigasjon AS (NPN). NPN was, however, the first company to spud a well at Kvadehuken near Ny-Ålesund in 1961. This drilling marked the start of an exciting period of petroleum exploration on Svalbard, with eighteen exploration wells drilled in the period from 1961 to 1994 by a mix of Norwegian and international companies. The deepest borehole thus far, Caltex's Ishøgda-I near Van Mijenfjorden, reached 3304 m in 1966, the same year that the first exploration licenses were awarded in the Norwegian part of the North Sea. Norsk Polar Navigasjon, a small Norwegian private-equity firm from Trondheim, was involved in nine of the eighteen wells. The remaining wells were drilled by American (Caltex/Amoseas), Belgian (Fina), French (Total), Russian (Trust Arktikugol) and the Norwegian companies Norsk Hydro and Store Norske Spitsbergen Kulkompani. None of the wells resulted in commercial discoveries, though several wells encountered gas in measurable quantities. Furthermore, more recent research and coal exploration boreholes have confirmed moveable hydrocarbons in close proximity to the Longyearbyen and Pyramiden settlements. In this contribution, we present a historical and brief geological overview of the petroleum exploration wells onshore Svalbard, the often overlooked but important part of the Norwegian oil exploration history. We illustrate that the eighteen exploration boreholes have together penetrated over 29 km of stratigraphy, with the

Paleozoic-Mesozoic successions in particular well covered. As such, the petroleum exploration boreholes represent an important window to decipher the tectono-stratigraphic evolution of Svalbard and the greater Barents Shelf.

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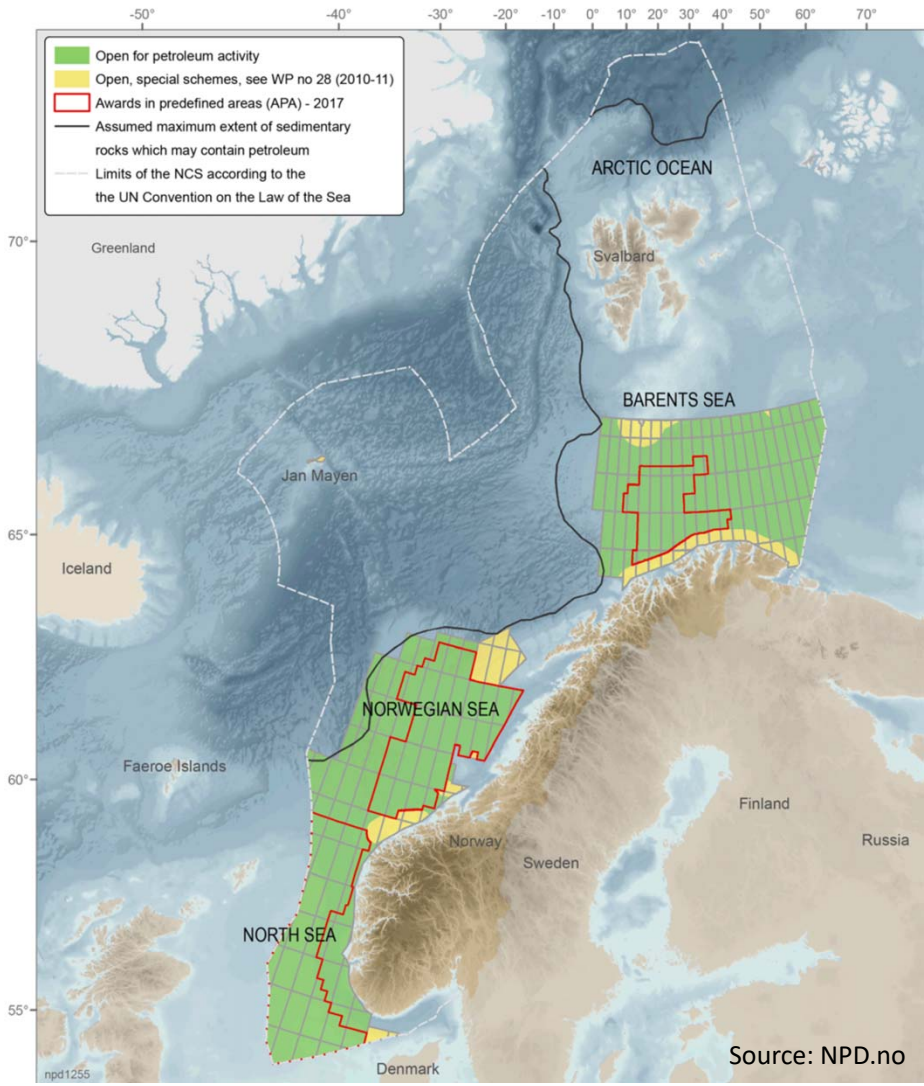
Session: **Step Changes in Petroleum Geology: Historical Challenges and Technological Breakthroughs**

19 May 2019, San Antonio, Texas

Norwegian oil industry

- First licensing round 1965
- First exploration drilling 1966
- First discovery 1967
- First major discovery 1969 (Ekofisk)
- First production 1971
- First Barents Sea license round 1980
- But what about Svalbard?



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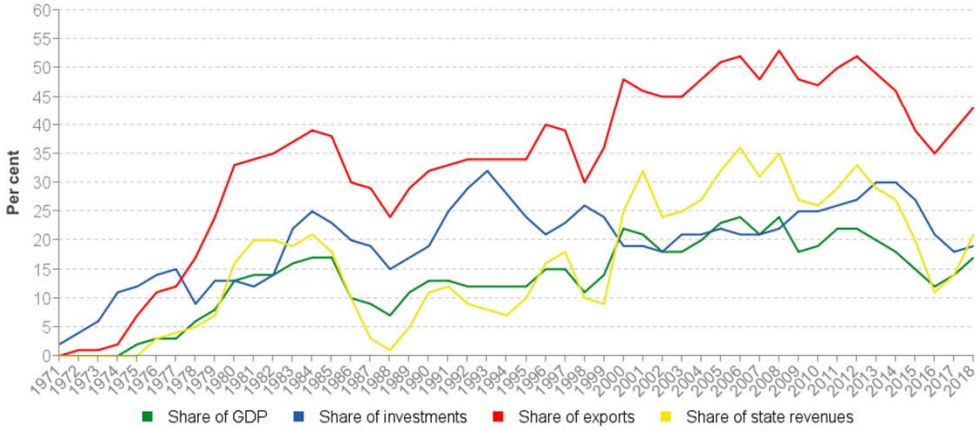
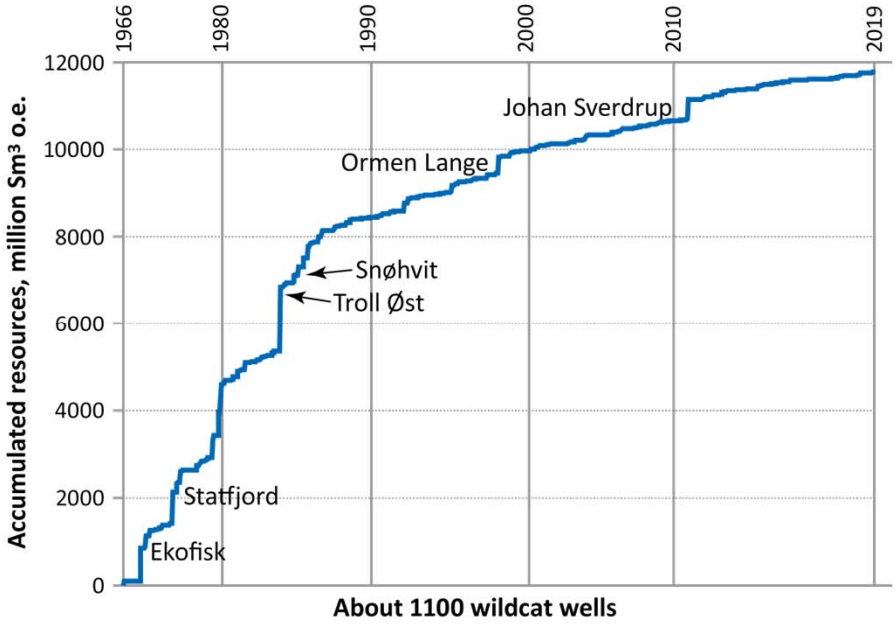
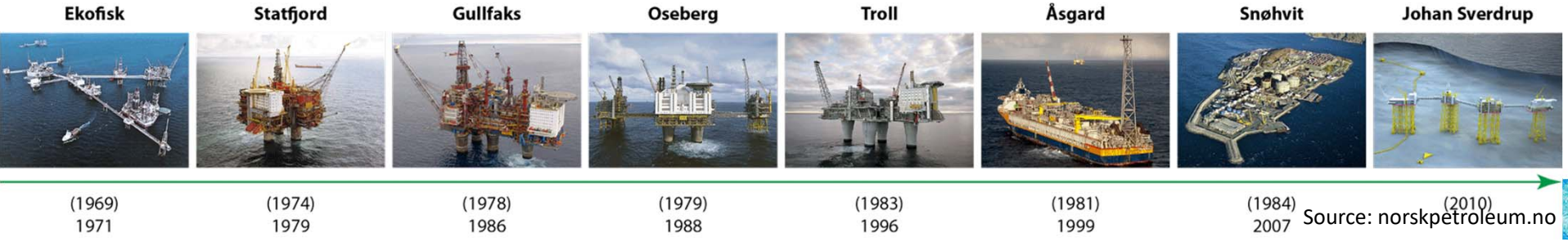
Norwegian oil industry



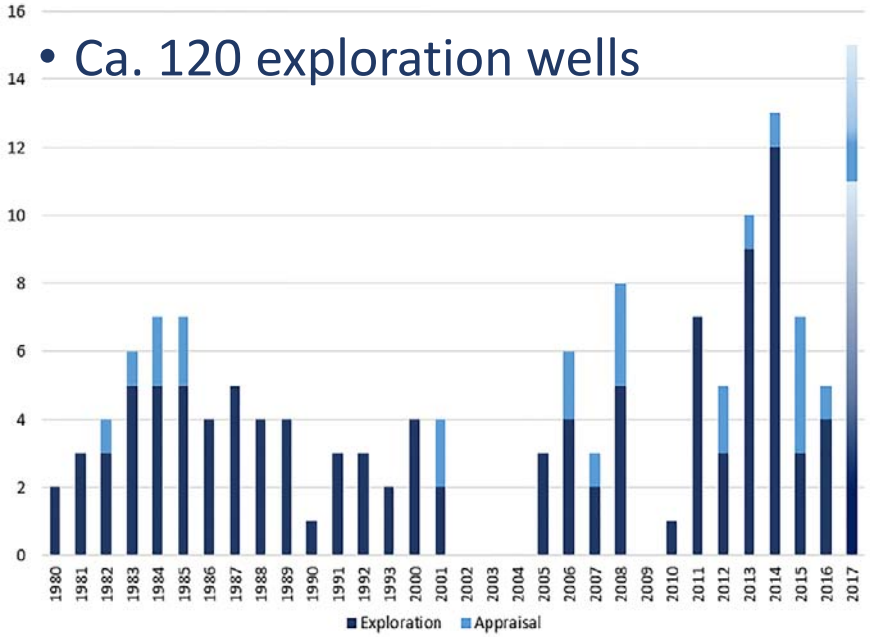




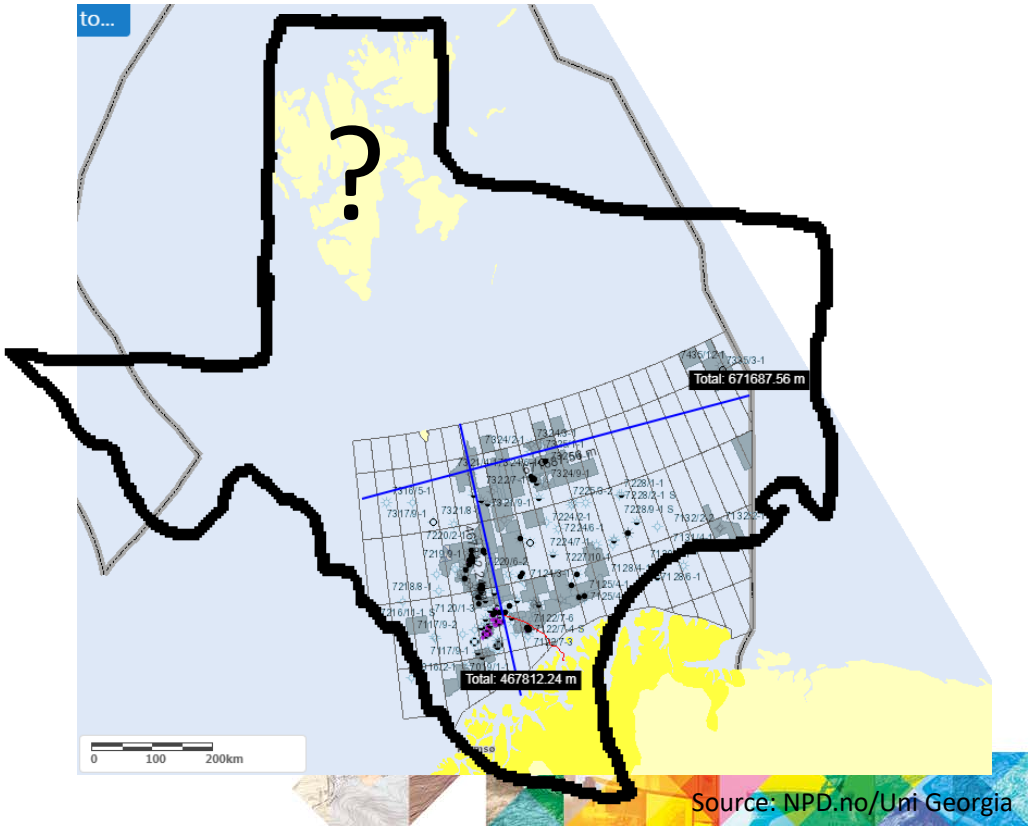
Source: norskpetroleum.no

Barents Sea: frontier province

- Two fields – Snøhvit and Goliat
- Discoveries to be developed
- Sub-commercial discoveries
- Ca. 120 exploration wells



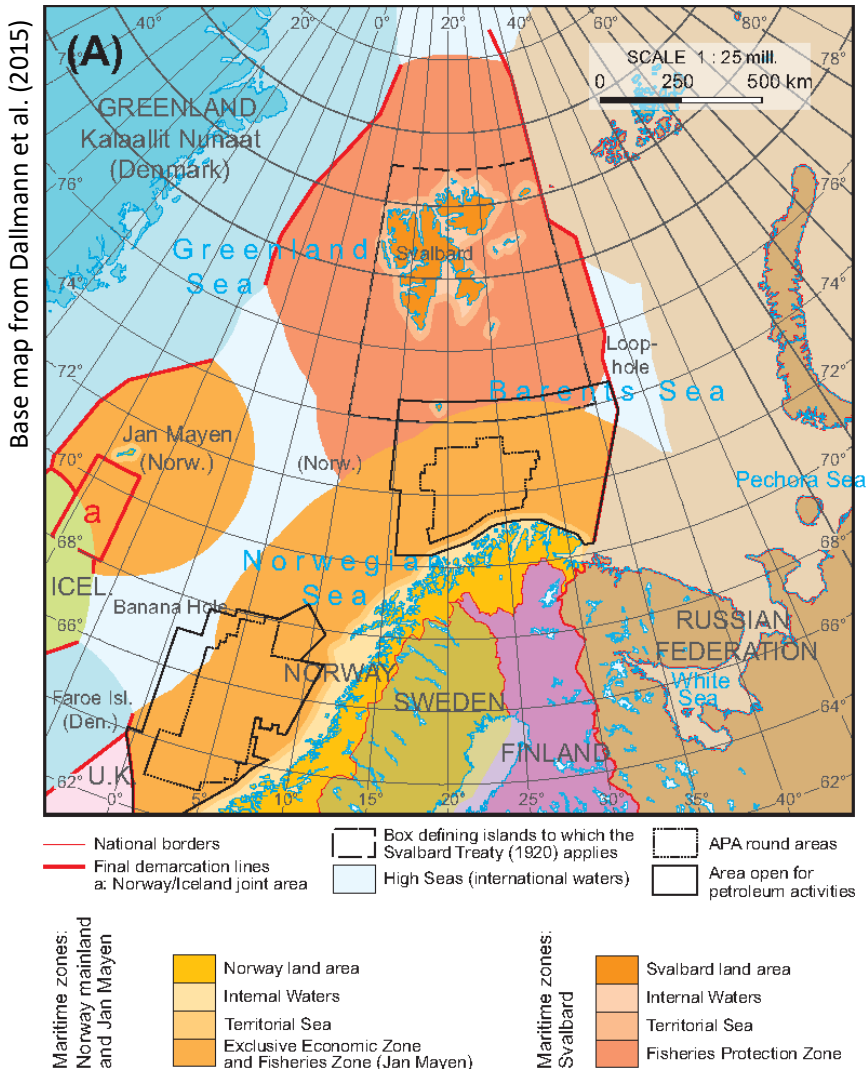
Source: Jakobsson (2018)



Source: NPD.no/Uni Georgia

Where and what is Svalbard?

- A Norwegian archipelago between 74°-81°N and 10°-35°E
- Permanent coal-mining settlements at Longyearbyen and Barentsburg, total population ca 2700 people
- Norwegian jurisdiction and laws applies everywhere in Svalbard, but is partly governed by the Svalbard Treaty

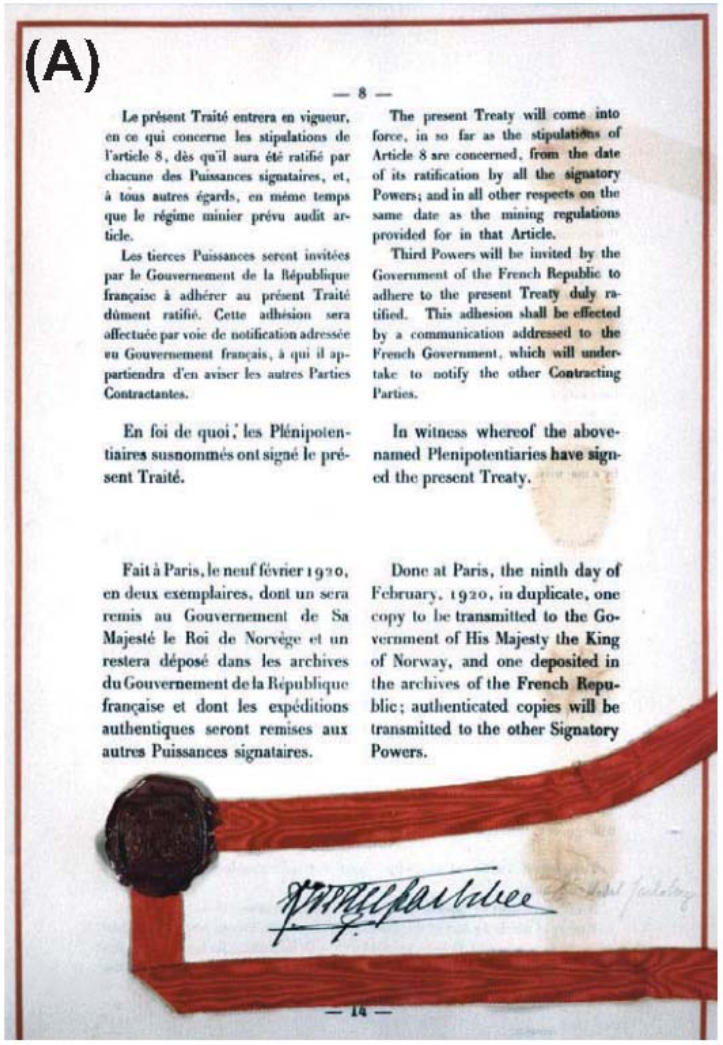


The Svalbard Treaty…

Signed 9 February 1920 in Paris, ratified 14 August 1925
Currently signed by 46 countries

…grants Norway's full and absolute sovereignty over Svalbard under four main conditions:

1) Tax collected in Svalbard can only be used in Svalbard,
2) Norway must respect and preserve Svalbard's environment,
3) All citizens of signatory countries have equal right to reside, work and exploit natural resources. Norway may regulate or forbid these activities but cannot discriminate on the basis of nationality.
4) Svalbard may not install military bases or be used for any war-like purpose.


(A)

— 8 —

Le présent Traité entrera en vigueur, en ce qui concerne les stipulations de l'article 8, dès qu'il aura été ratifié par chacune des Puissances signataires, et, à tous autres égards, en même temps que le régime minier prévu audit article.

Les tierces Puissances seront invitées par le Gouvernement de la République française à adhérer au présent Traité dûment ratifié. Cette adhésion sera affectuée par voie de notification adressée au Gouvernement français, à qui il appartiendra d'en aviser les autres Parties Contractantes.

The present Treaty will come into force, in so far as the stipulations of Article 8 are concerned, from the date of its ratification by all the signatory Powers; and in all other respects on the same date as the mining regulations provided for in that Article.

Third Powers will be invited by the Government of the French Republic to adhere to the present Treaty duly ratified. This adhesion shall be effected by a communication addressed to the French Government, which will undertake to notify the other Contracting Parties.

En foi de quoi, les Plénipotentiaires susnommés ont signé le présent Traité.

In witness whereof the above-named Plenipotentiaries have signed the present Treaty.

Fait à Paris, le neuf février 1920, en deux exemplaires, dont un sera remis au Gouvernement de Sa Majesté le Roi de Norvège et un restera déposé dans les archives du Gouvernement de la République française et dont les expéditions authentiques seront remises aux autres Puissances signataires.

Done at Paris, the ninth day of February, 1920, in duplicate, one copy to be transmitted to the Government of His Majesty the King of Norway, and one deposited in the archives of the French Republic; authenticated copies will be transmitted to the other Signatory Powers.

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Dallmann et al. (2015)

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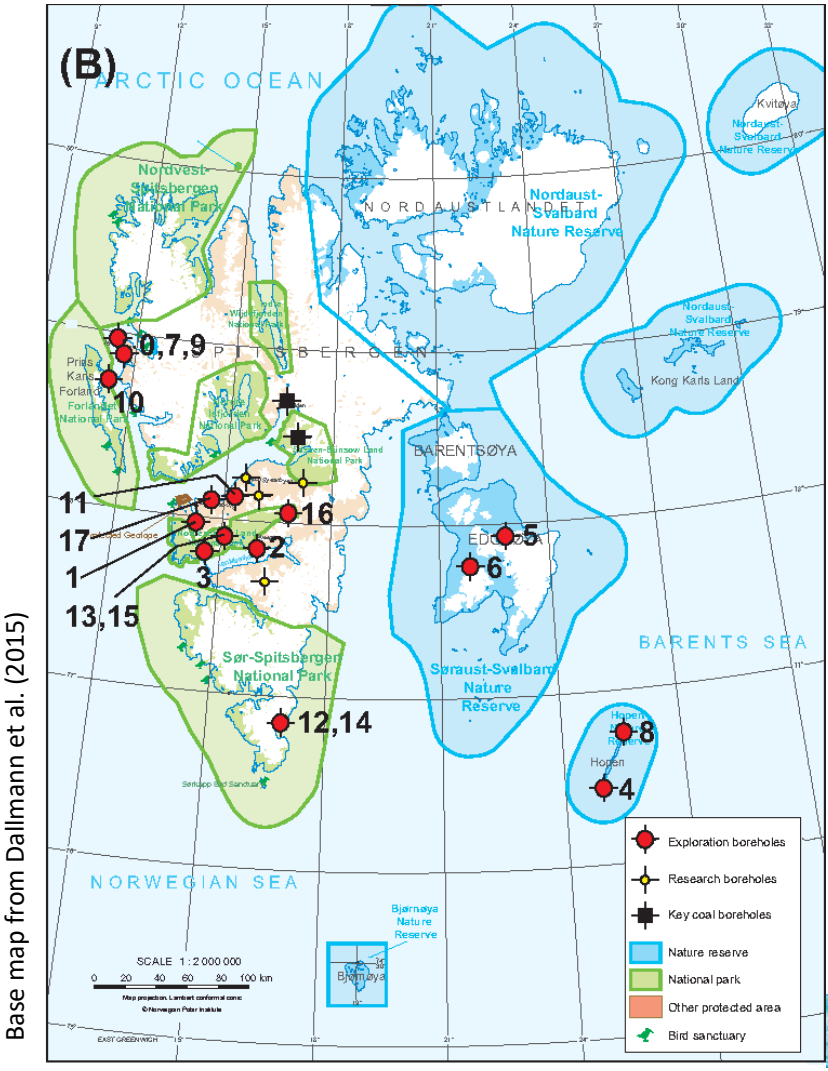
Where and what is Svalbard?

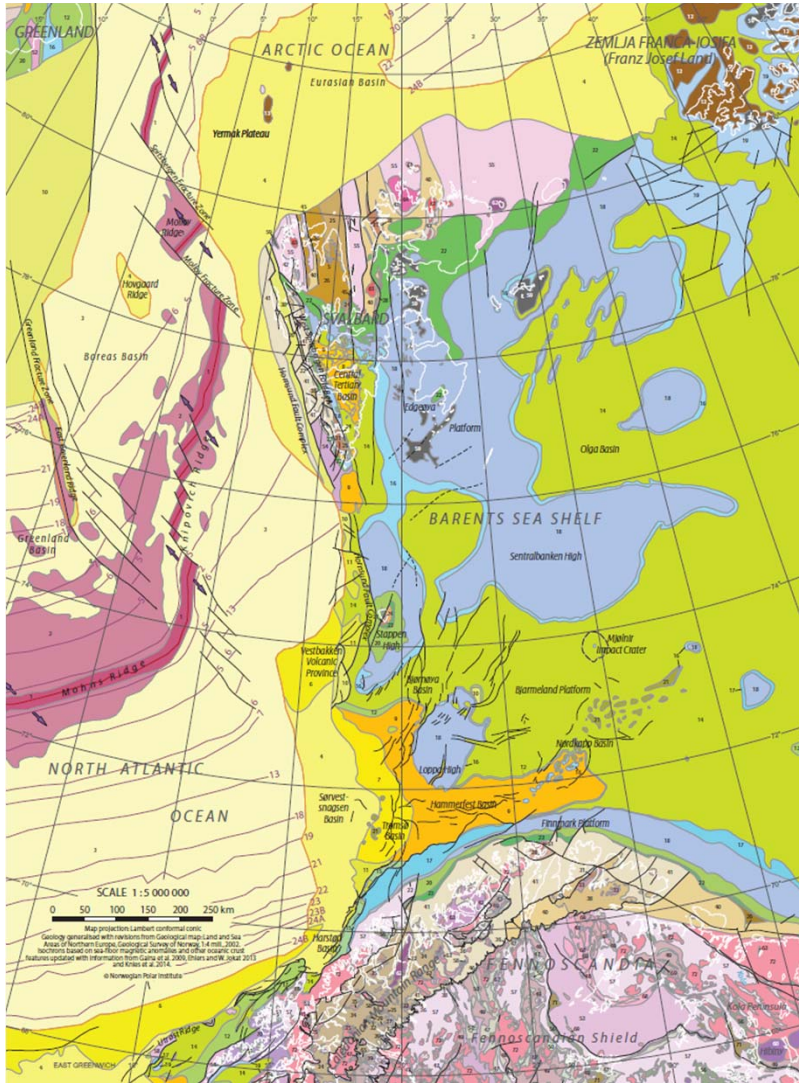
- Main islands are Spitsbergen, Nordaustlandet, Edgeøya, Barentsøya, Prins Karls Forland, Hopen and Bjørnøya
- Much of the archipelago is presently protected as a nature reserve or national park
- Geologically part of the Barents Shelf
- 18 petroleum exploration boreholes were drilled in Svalbard from 1961 to 1994



Base map from Dallmann et al. (2015)

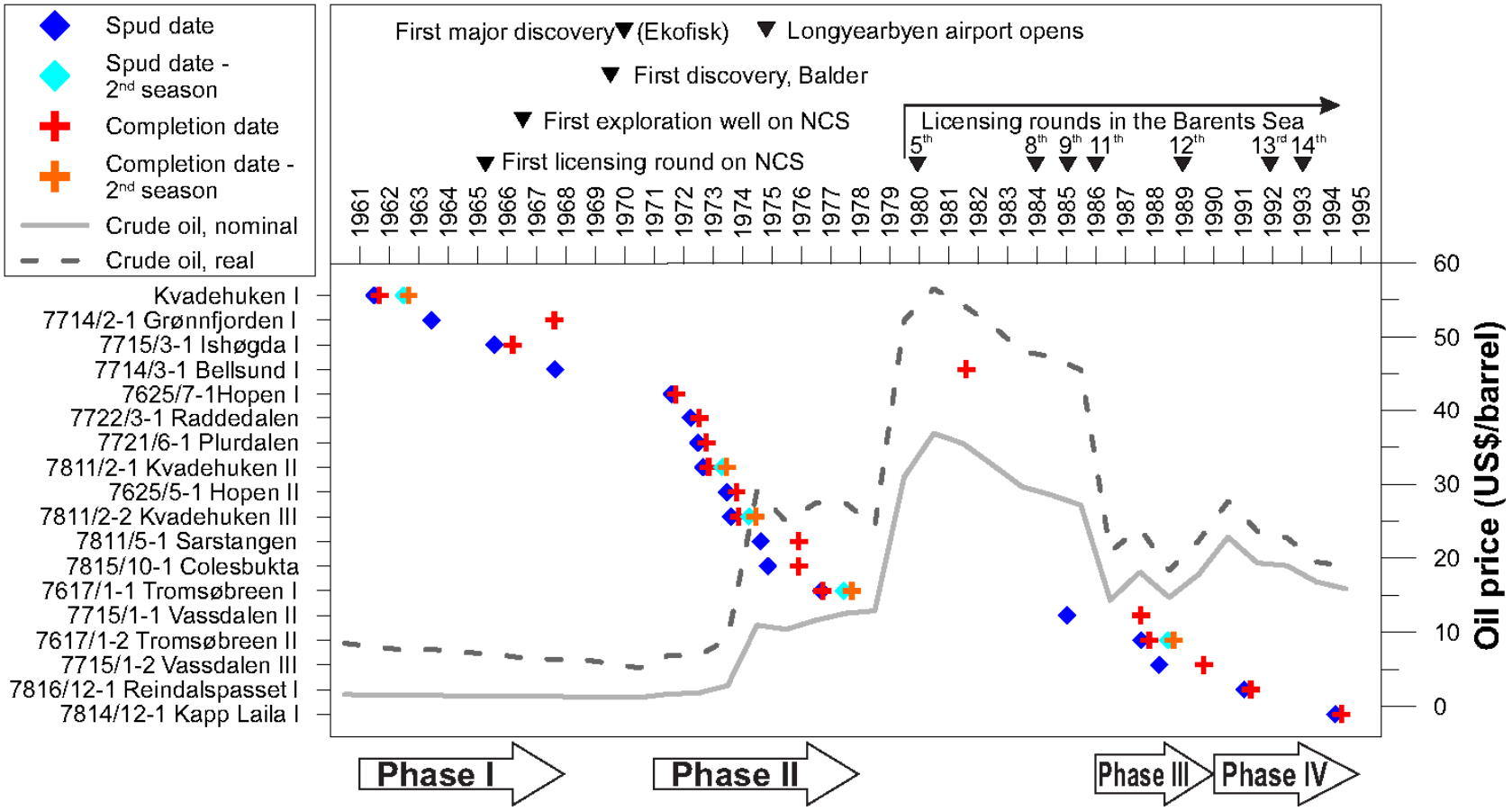
Why did they drill?

- Geology
  - Sedimentary units comprising source and reservoir rocks
  - Oil staining at outcrops and some gas seeps
- «Easy» access
- Predictable and favourable tax regime
- Stable politics
- Relatively close to energy markets
- Coal-mining suggests year-round operations are feasible in Svalbard

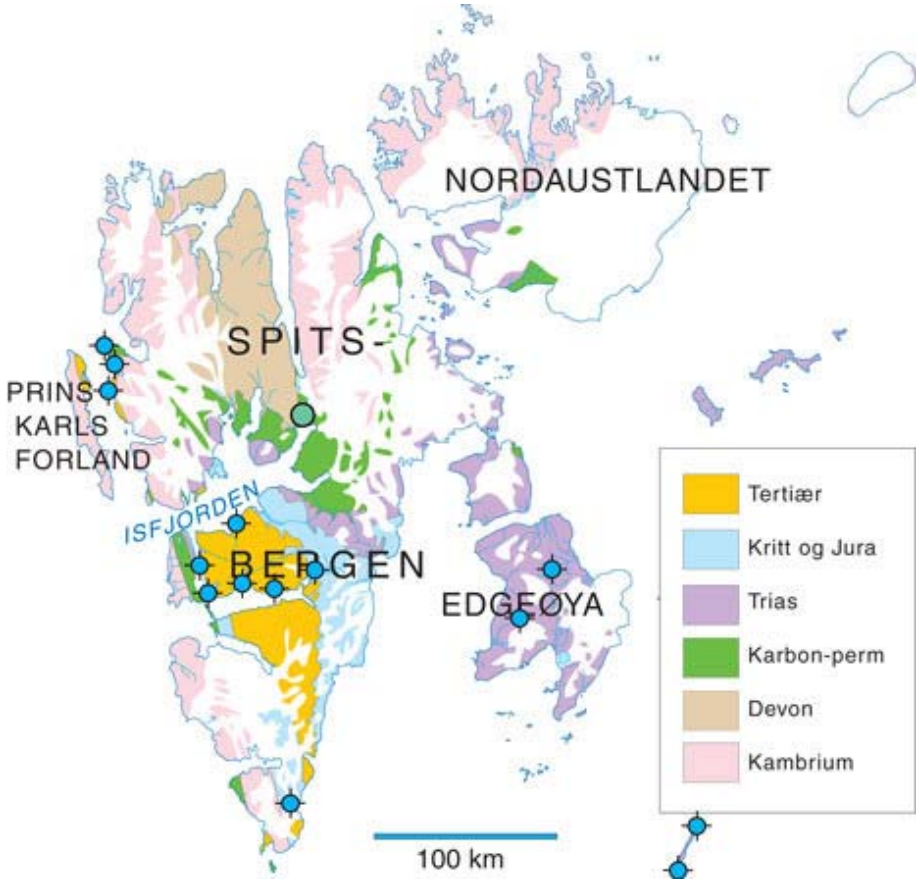


Dallmann et al. (2015)

Svalbard exploration drilling



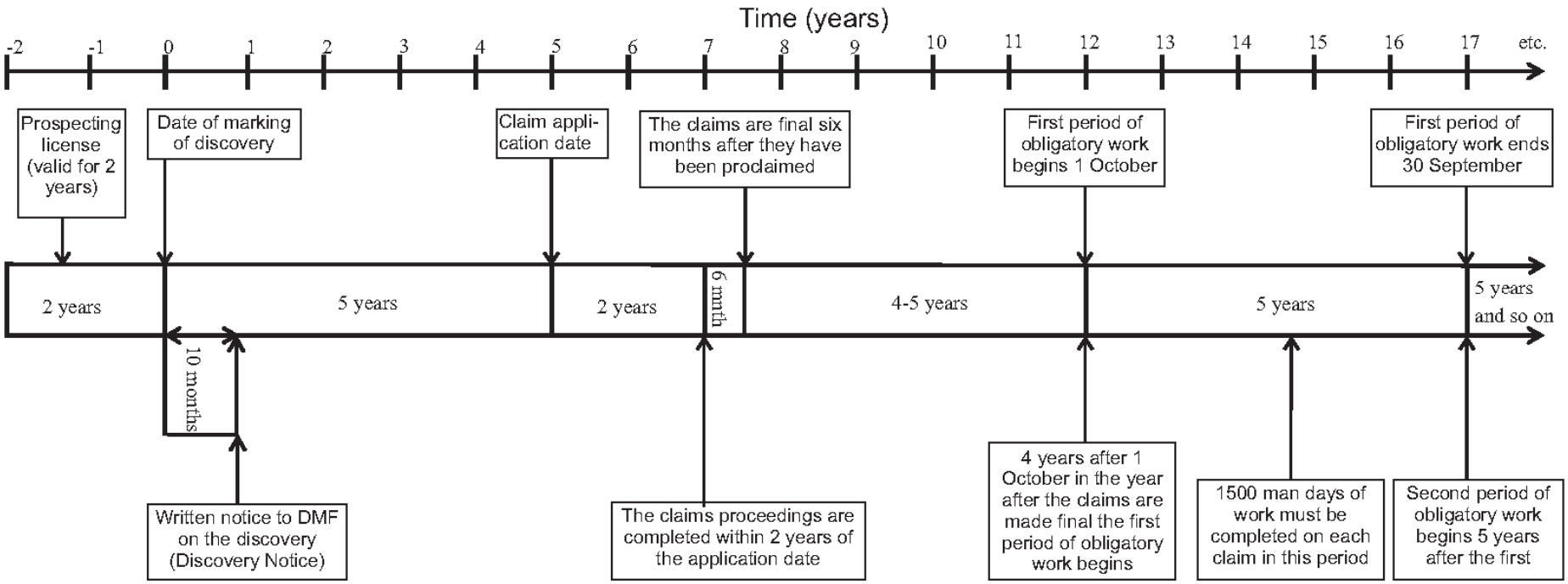
Svalbard exploration drilling



Borehole	*Year*	*Company*	*Depth*
Grønfjorden	1963-67	Norsk Polarnavigasjon A/S	972 m
Ishøgda	1965-66	Texaco / Caltex Group	3304 m
Bellsund 1	1967-81	Norsk Polarnavigasjon A/S	405 m
Hopen 1	1971	Forasol / Fina Group	908 m
Plurdalen	1972	Fina / Fina Group	2351 m
Raddedalen	1972	Total / Caltex Group	2823 m
Kvadehuken 1	1972-74	Terratest A/S / No. Polarnavigasjon A/S	479 m
Hopen 2	1973	Westburne Int.Ltd. / Fina Group	2840 m
Kvadehuken 2	1973-74	Terratest A/S / No. Polarnavigasjon A/S	394 m
Sarstangen	1974	Terratest A/S / No. Polarnavigasjon A/S	1113 m
Colesbukta	1974-75	Trust Arktikugol	3173 m
Tromsøbreen 1	1976-77	Terratest A/S / No. Polarnavigasjon A/S	996 m
Vassdalen 2	1985-87	Trust Arktikugol	2481 m
Vassdalen 3	1988-89	Trust Arktikugol	2315 m
Tromsøbreen 2	1987-88	Deutag / Tundra A/S and partners	2337 m
Reindalspasset	1991	Aker-Deutag / Norsk Hydro-SNSK-PA	2315 m
Kapp Laila	1994	SNSK / SNSK-Hydro-Trust Arktikugol	504 m

Dallmann et al. (2015)

Claiming land in Svalbard



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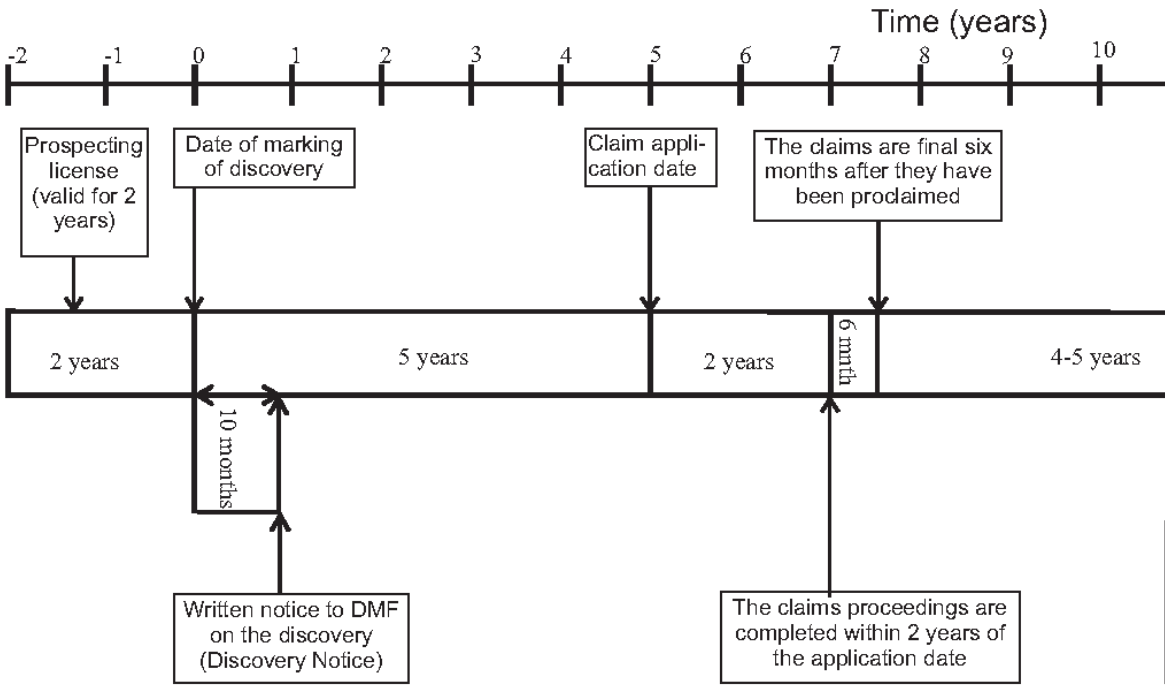
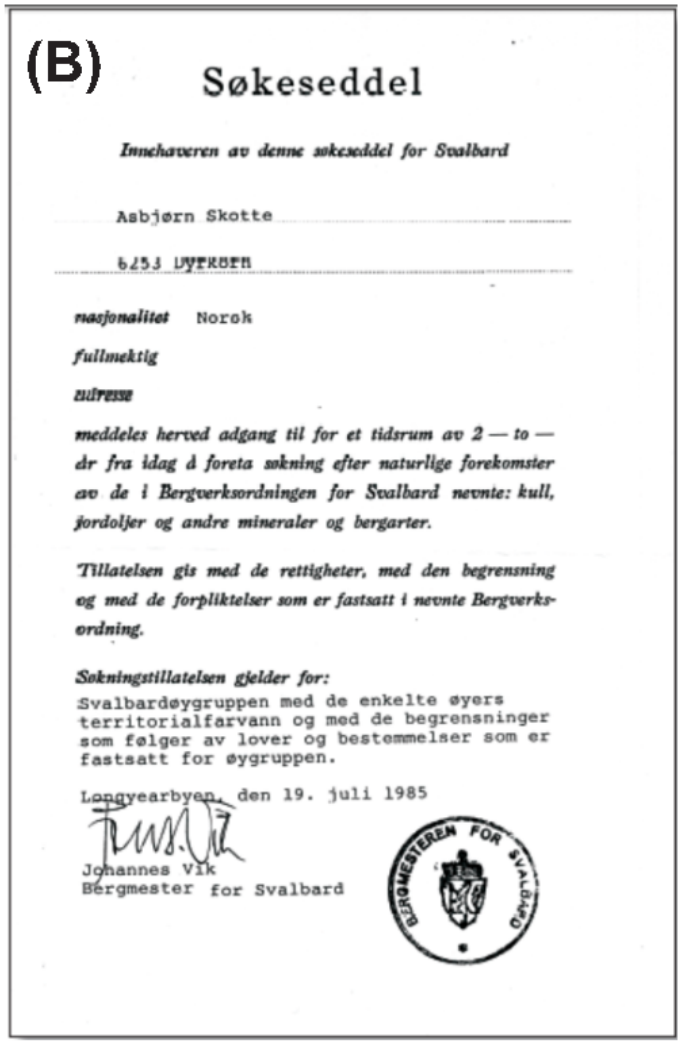




(B)

Søkeseddel

Innehaveren av denne søkeseddel for Svalbard

Asbjørn Skotte

6253 Dyrkorn

nasjonalitet Norsk

fullmektig

adresse

meddeles herved adgang til for et tidsrum av 2 — to — år fra idag å foreta søkning efter naturlige forekomster av de i Bergverksordningen for Svalbard nevnte: kull, jordoljer og andre mineraler og bergarter.

Tillatelsen gis med de rettigheter, med den begrensning og med de forpliktelser som er fastsatt i nevnte Bergverksordning.

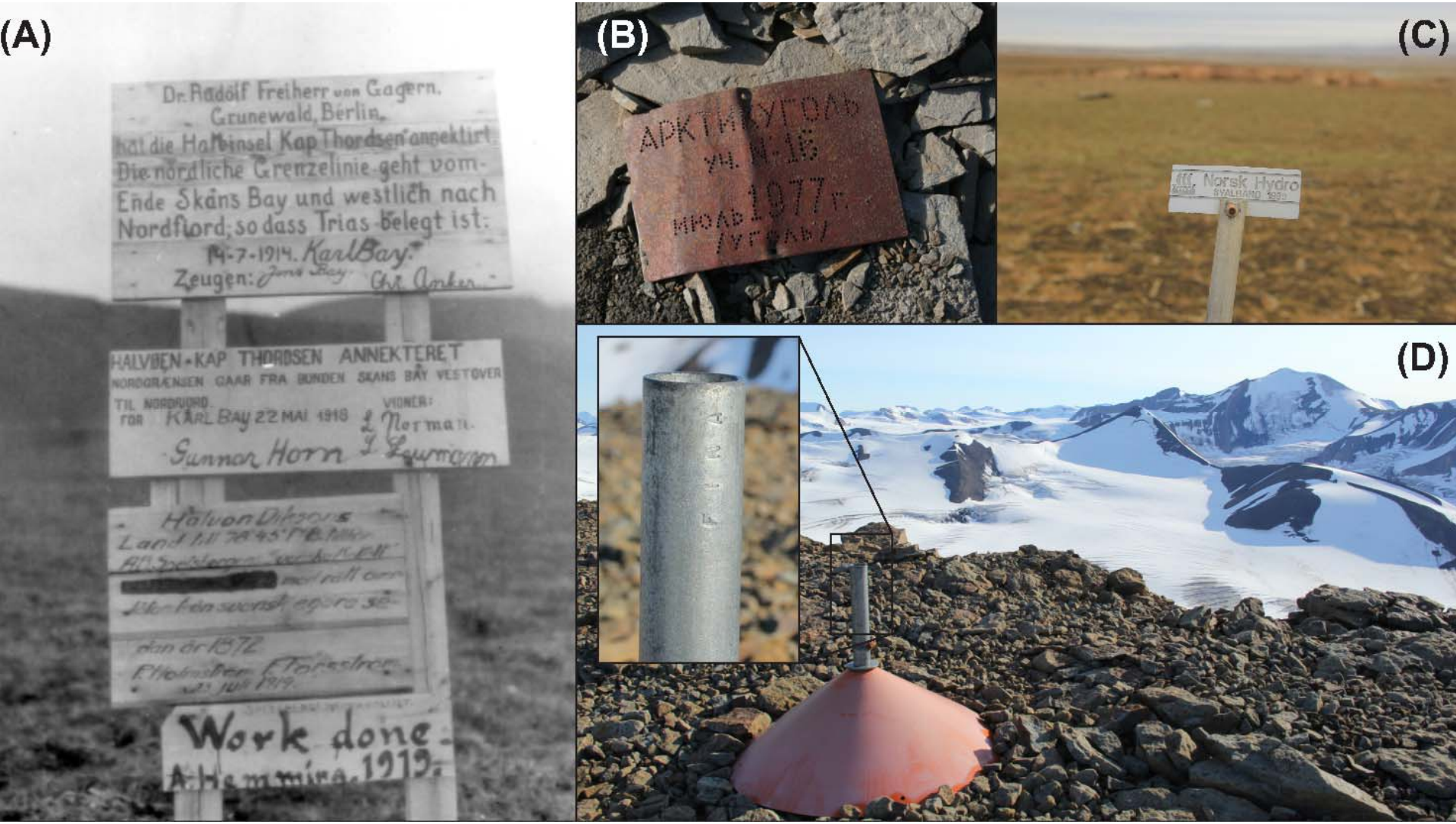
Søkningstillatelsen gjelder for:

Svalbardøygruppen med de enkelte øyers territorialfarvann og med de begrensninger som følger av lover og bestemmelser som er fastsatt for øygruppen.

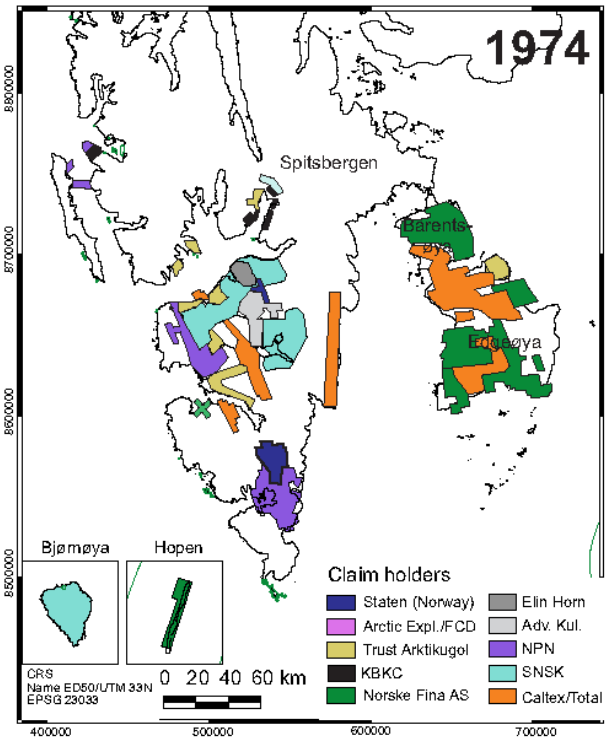
Longyearbyen, den 19. juli 1985

Johannes Vik
Bergmester for Svalbard

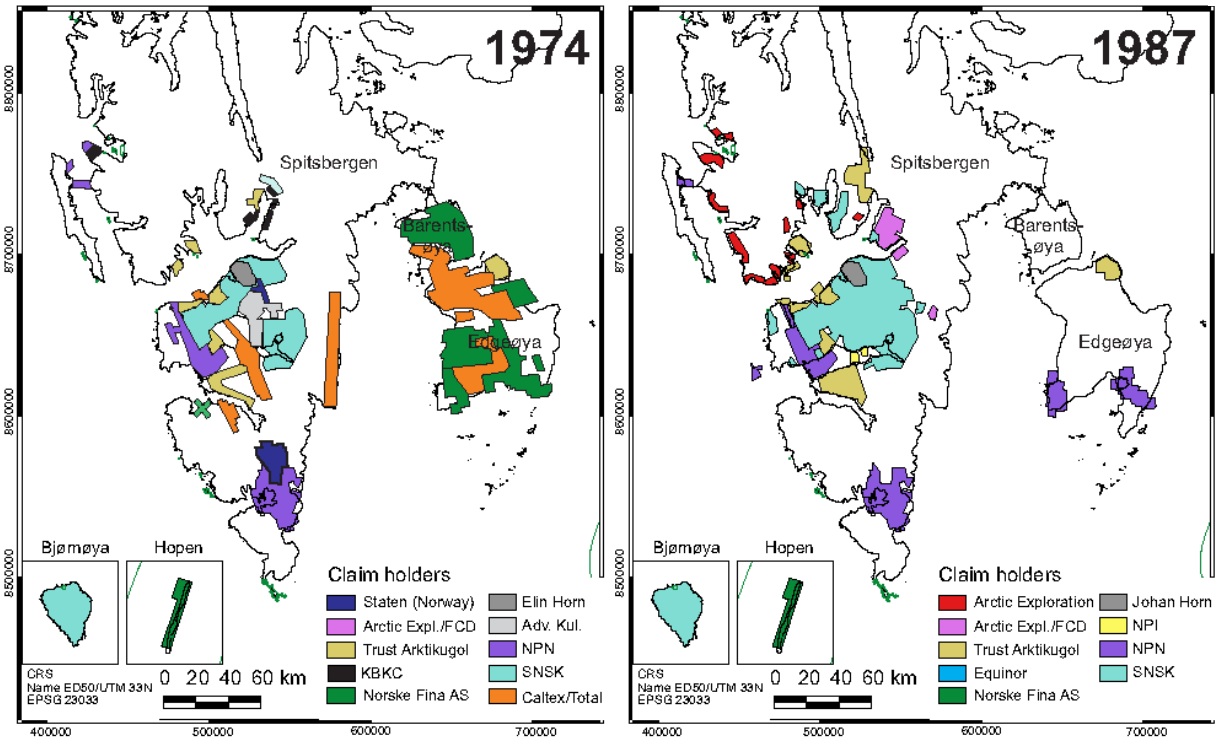
BERGMESTEREN FOR SVALBARD


(A)
Dr. Rudolf Freiherr von Gagern.
Grunewald, Berlin,
hat die Halbinsel Kap Thordsen annektirt.
Die nördliche Grenzelinie geht vom
Ende Skåns Bay und westlich nach
Nordfiord; so dass Trias belegt ist:
14-7-1914. Karl Bay.
Zeugen:
HALVØEN - KAP THORDSEN ANNEKTERET
NORDGRÆNSEN GAAR FRA BUNDEN SKANS BAY VESTOVER
TIL NORDFJORD
FOR KARL BAY 22 MAI 1918
VIDNER:
Sunnar Horn
Work done
(B)
(C)
Norsk Hydro
(D)

Claiming land in Svalbard



Claiming land in Svalbard



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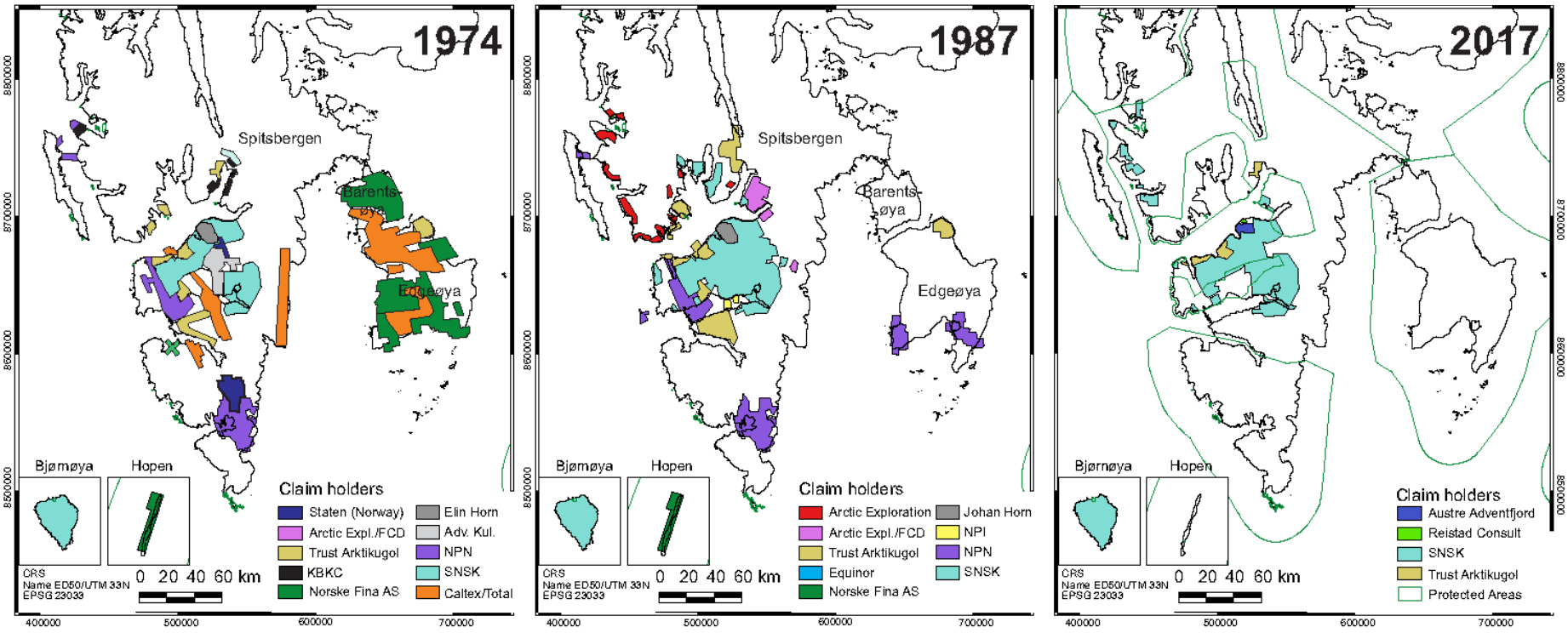

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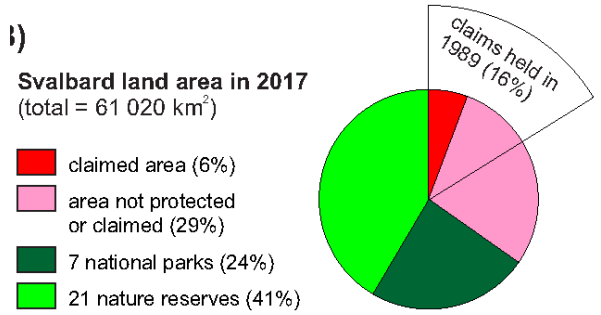
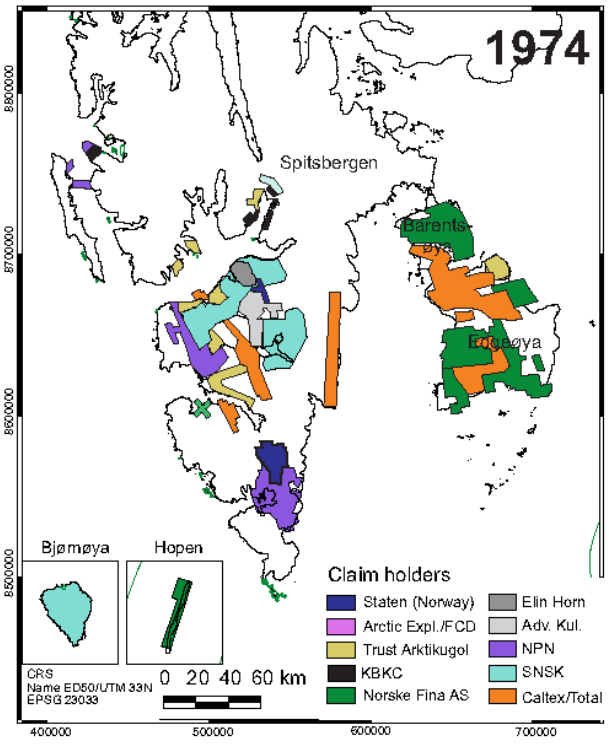
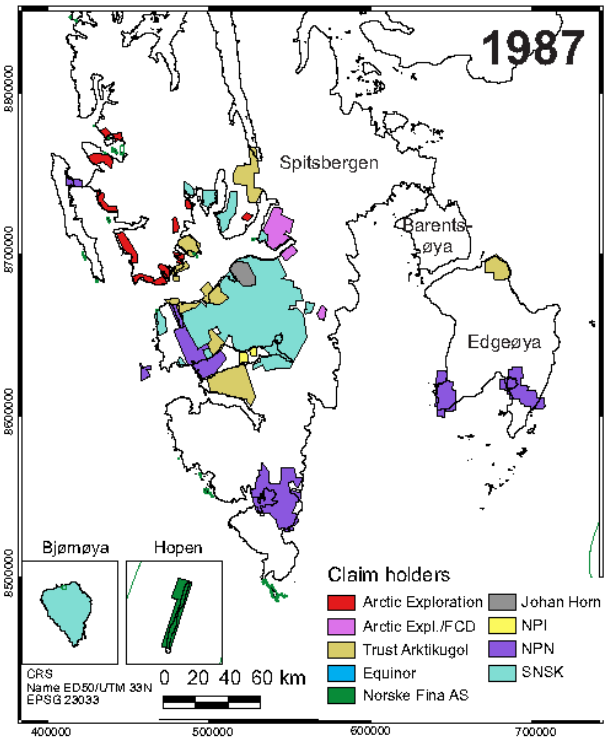
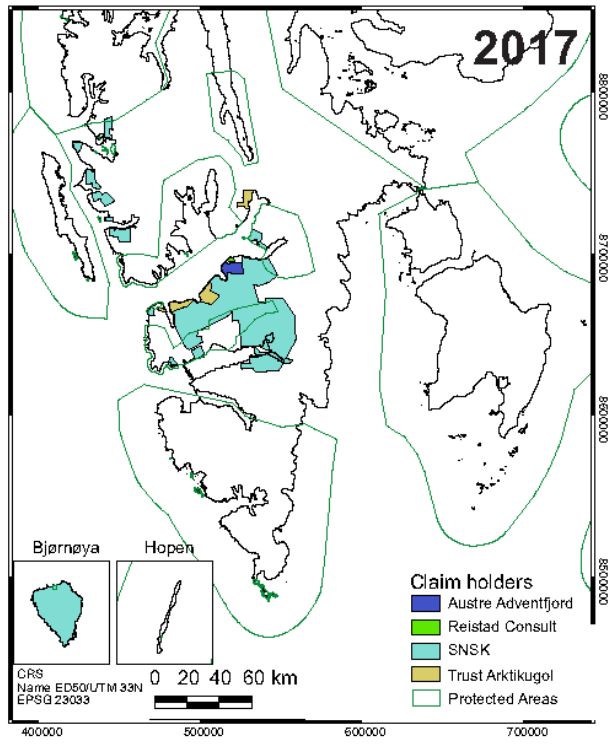
Claiming land in Svalbard









Early exploration efforts - 1920

Exploration drilling: Phase I

- Geological exploration by Shell, Caltex and Norsk Polar Navigasjon (NPN)
- NPN initially wanted to build an airport, but turned to oil exploration instead
- First drilling at Kvadehuken in summer 1961 (2 m depth reached)

Exploration drilling: Phase I

- Deepest borehole thus far – 3304 m / 10840 ft
- Drilled 1965-66 by Caltex
- 900 tons of equipment
- Minor gas shows only

Foto: Carl A. Wendt

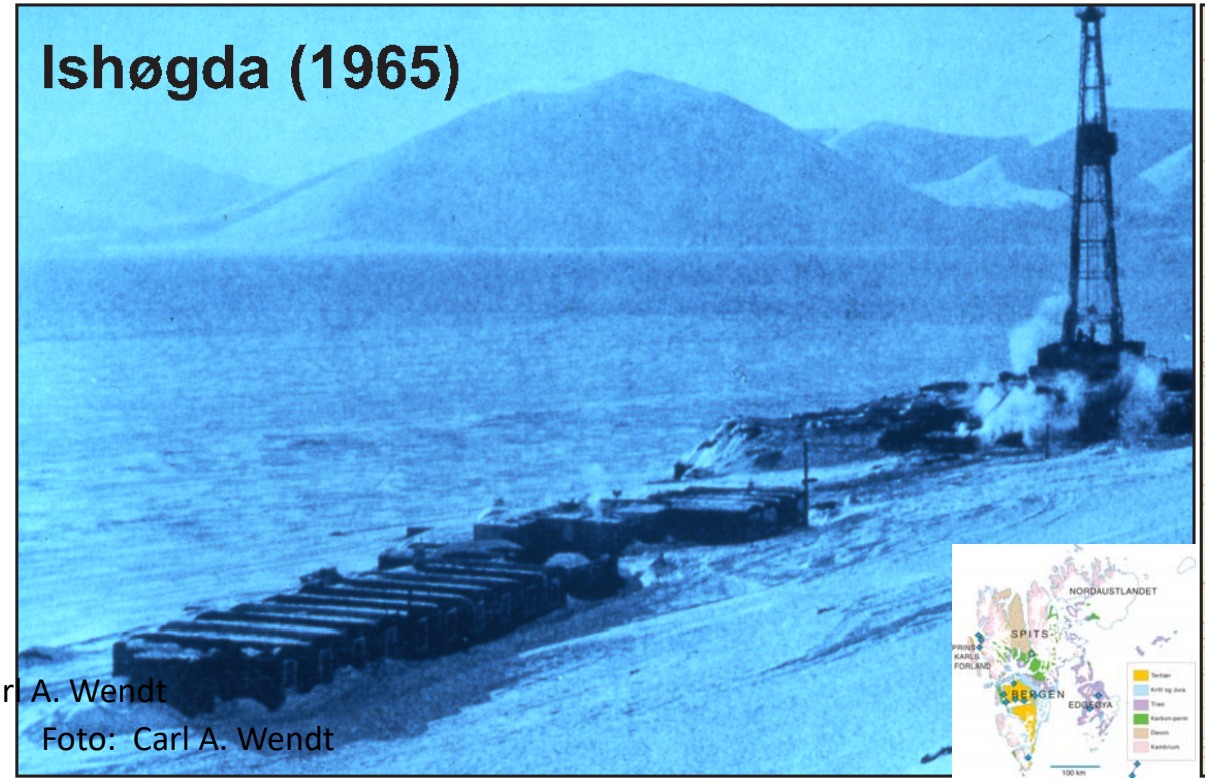


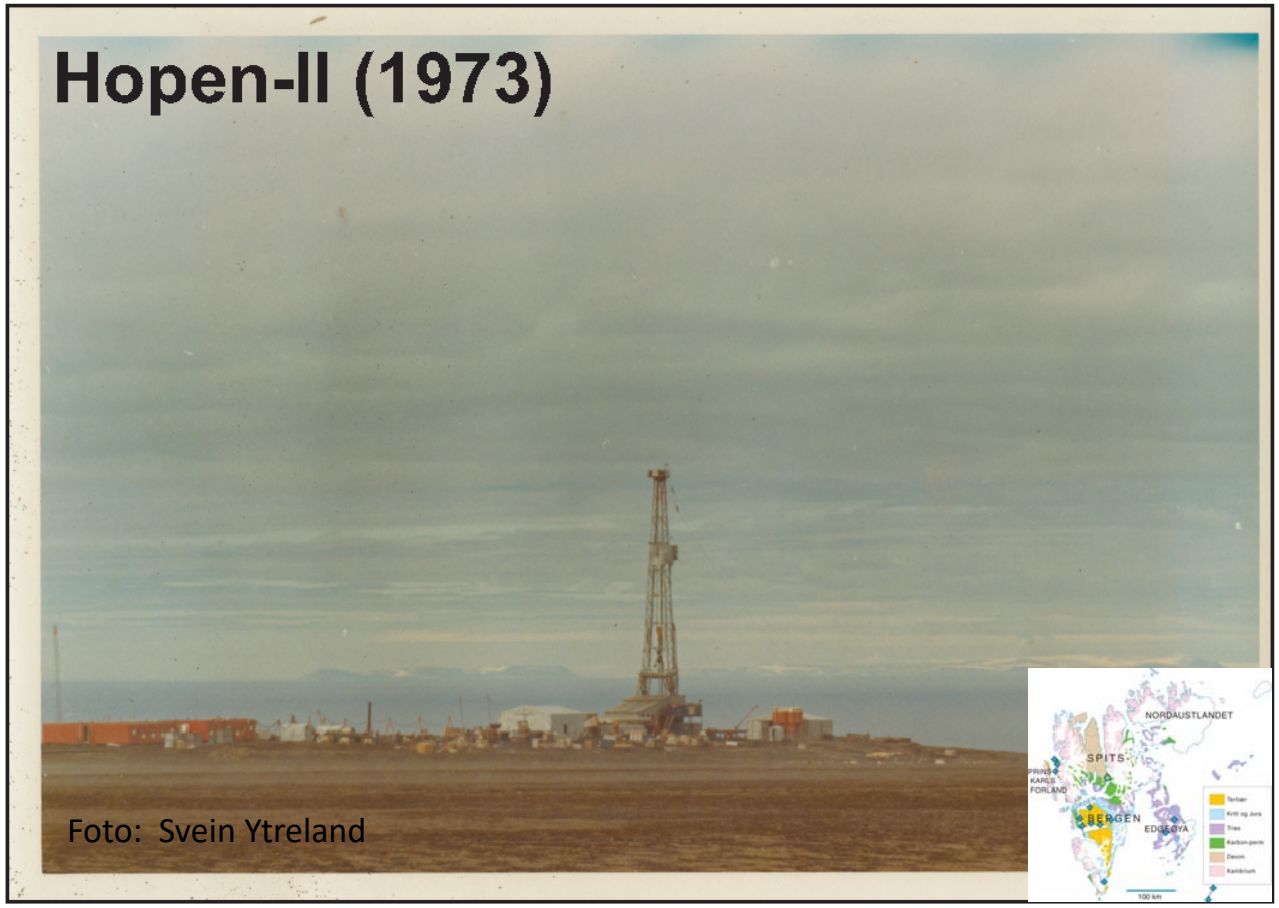
Foto: Carl A. Wendt

Exploration drilling: Phase II

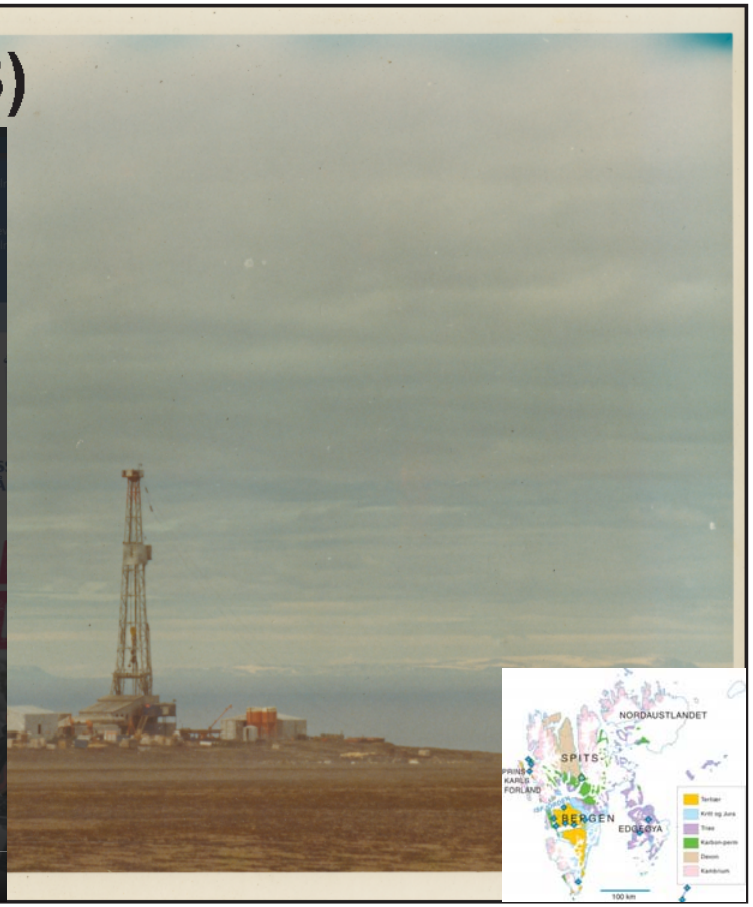
- Raddedalen (by Total) and Plurdalen (by Fina/NPN) both drilled on Edgeøya in 1972
- Significant depths of 2823 and 2351 m, respectively
- No gas encountered
- Similar stratigraphy in uppermost 1 km, but dramatically different below 1 km

Exploration drilling: Phase II

- Drilled by Fina (with NPN)
- Total depth: 2823 m
- Well drilled on basis of near-shore seismic mapping
- Traces of gas in Triassic section
- Important calibration point for seismic interpretation from Svalbard to SW Barents Shelf

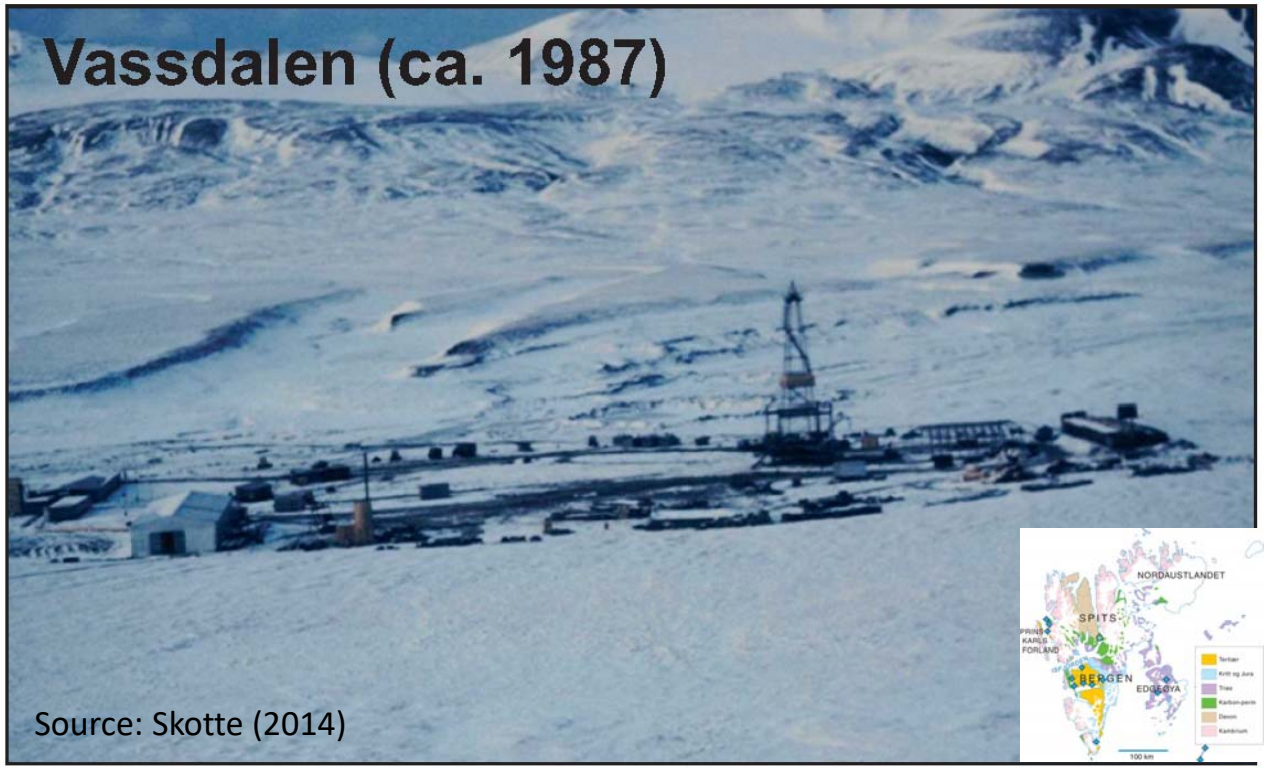


Exploration drilling: Phase II



Exploration drilling: Phase III

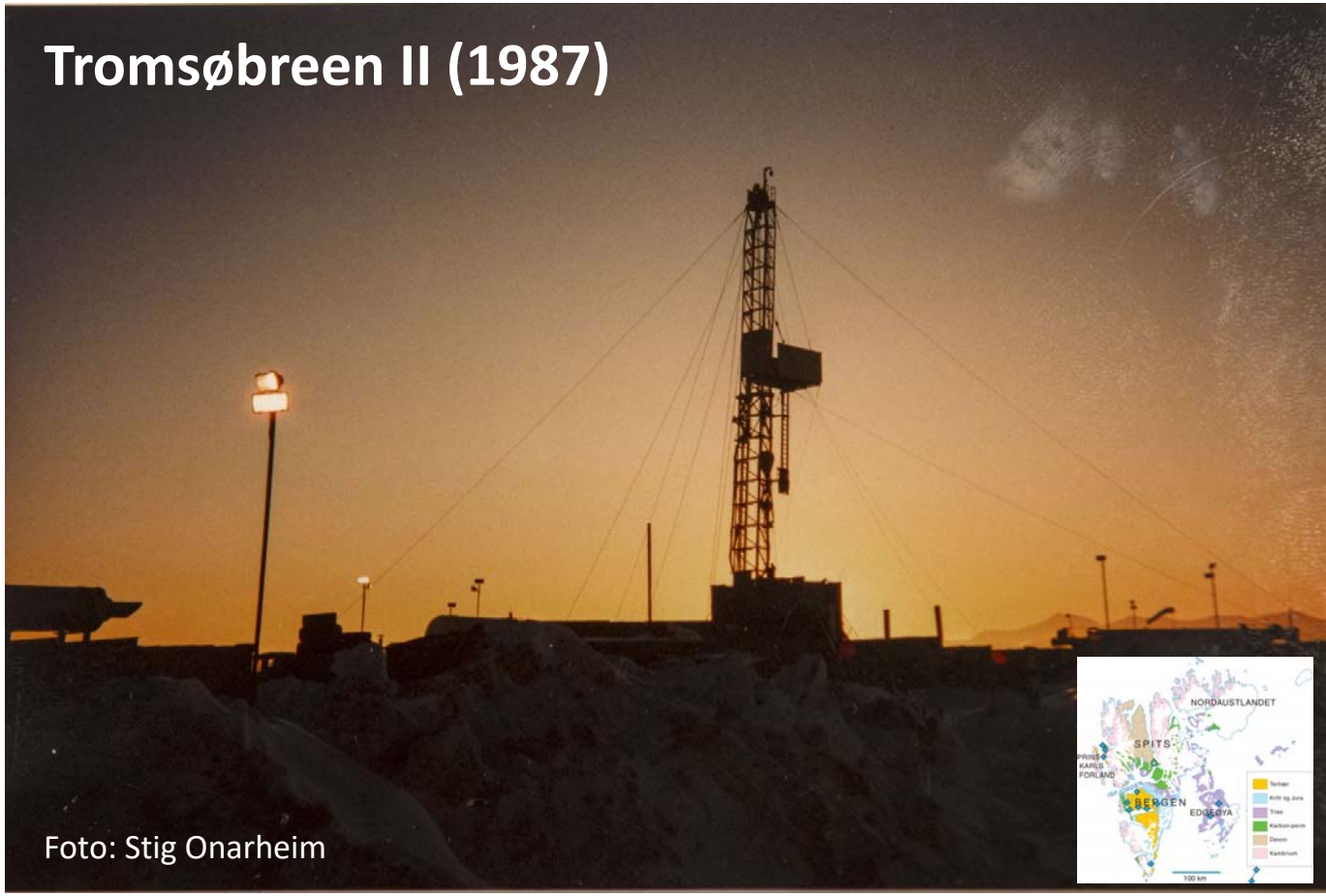
- Russian coal-mining company Trust Arktikugol drilled 3 deep boreholes – Colesbukta in 1974 and Vassdalen II and III in late 1980s
- Defined as stratigraphic boreholes, but hit some minor gas



Source: Skotte (2014)

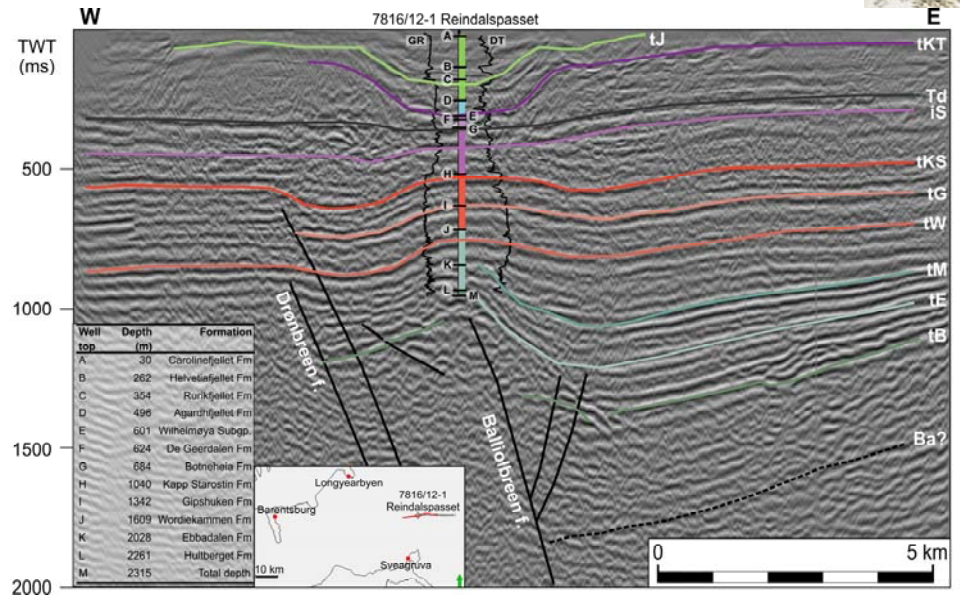
Exploration drilling: Phase III

- NPN traded claim acreage for drilling, which was carried by Swedish company Polargas Prospektering AB
- Gas tested at numerous intervals of the 2337 m deep borehole
- Up to 15 polar bears per day (!) reported at the drill site



Exploration drilling: Phase IV

- Drilled by Norsk Hydro/Petro Arctic/SNSK on a seismically defined structure
- Minor gas shows and very poor reservoirs encountered



Source: Burgmans (2008)

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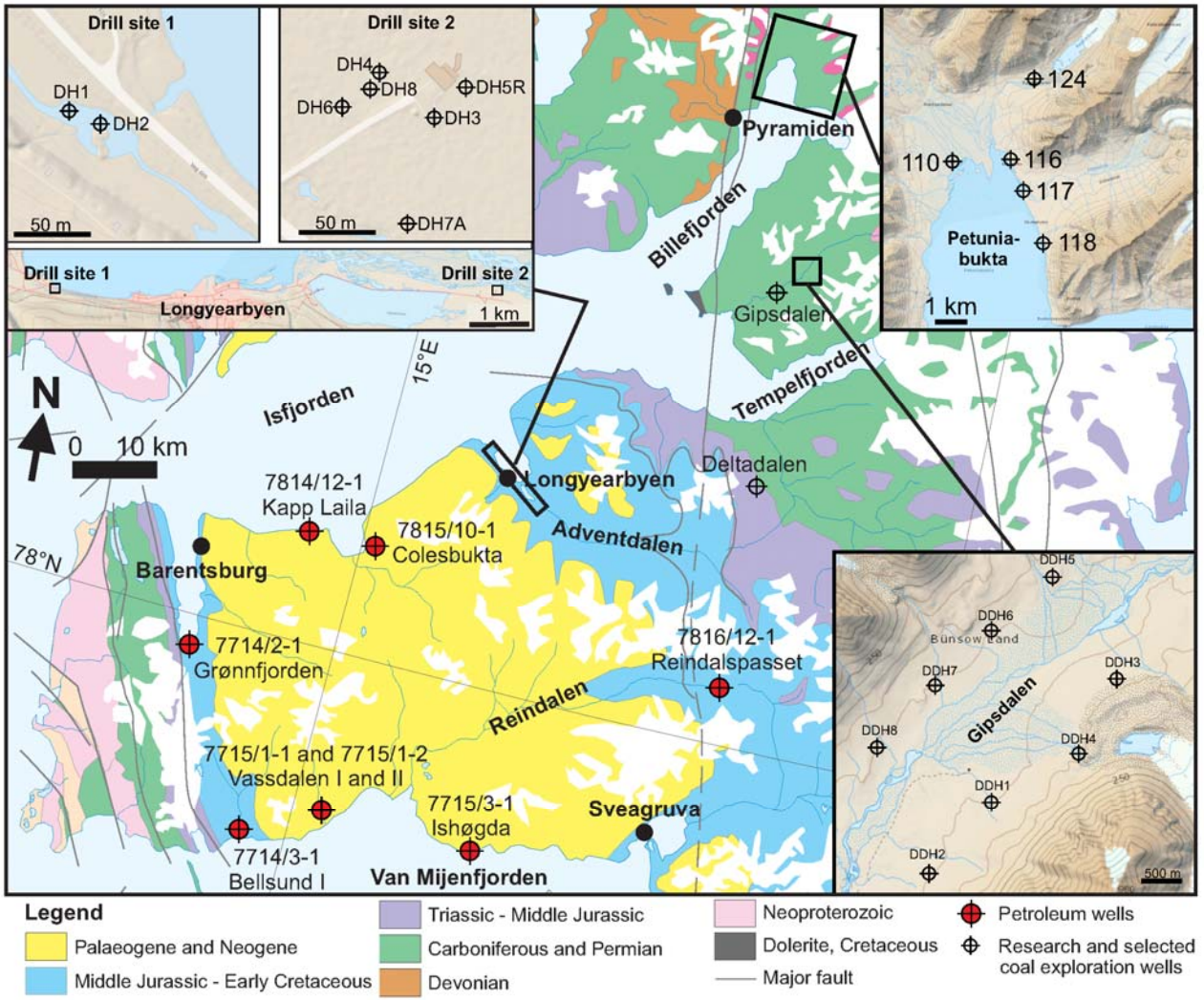
A technical discovery – thanks to coal drilling



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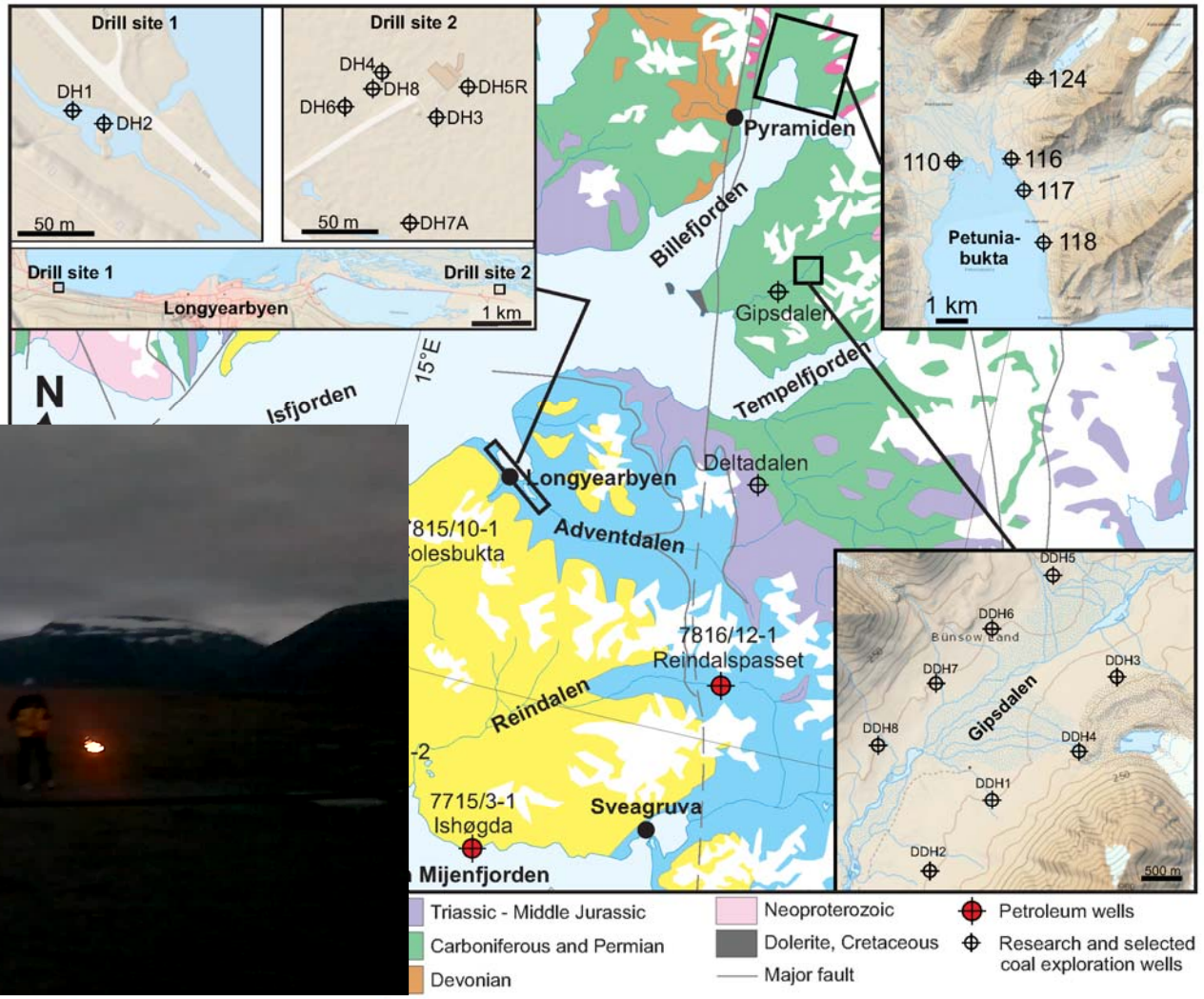
A technical discovery – thanks to research drilling



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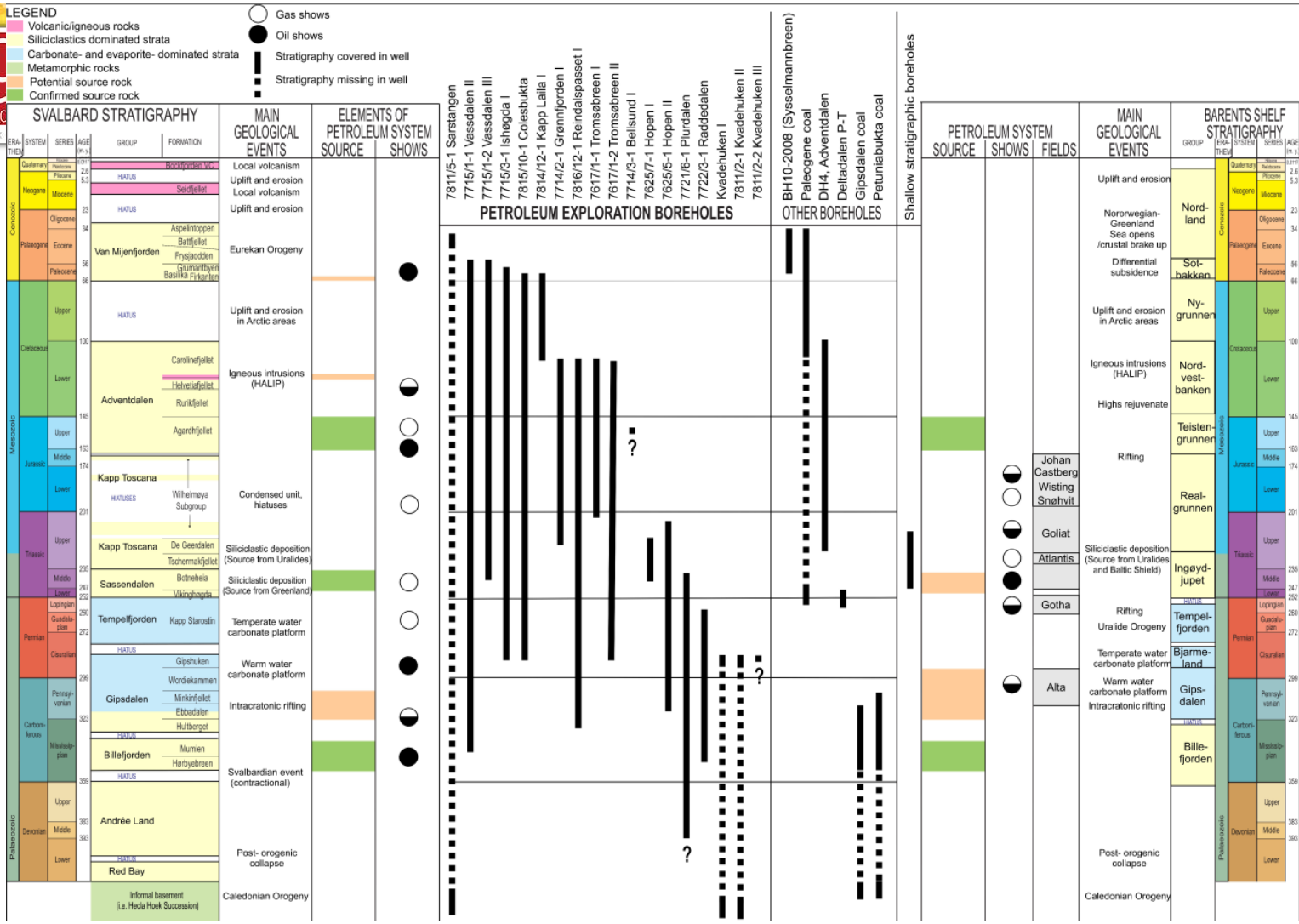
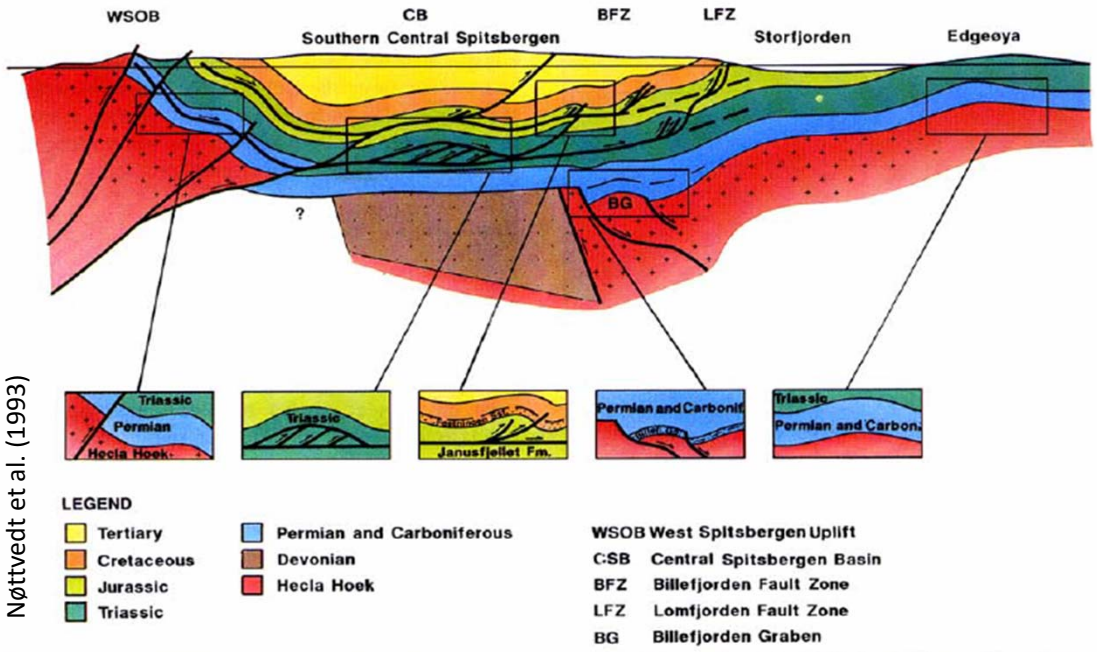
Borehole synthesis

- Cover large part of the stratigraphy
- Important link between geophysical data and outcrops
- Correlation between onshore-offshore domains



Why did they fail?

- Poor reservoir quality, especially in siliciclastics
- Lack of large-scale conventional traps
- Structural definition difficult in complex structural setting, especially without 2D seismic
- Significant burial and subseuqent uplift had negative impact on seal integrity
- Technical gas discoveries remain stranded (or for local use??)
- Increased environmental focus since 1970s significantly restricts petroleum exploration



Nøttvedt et al. (1993)

Fig. 21. Schematic illustration of structural trap styles across southern central Spitsbergen (van Mijenfjorden) and Edgeøya. Figure is not to scale.

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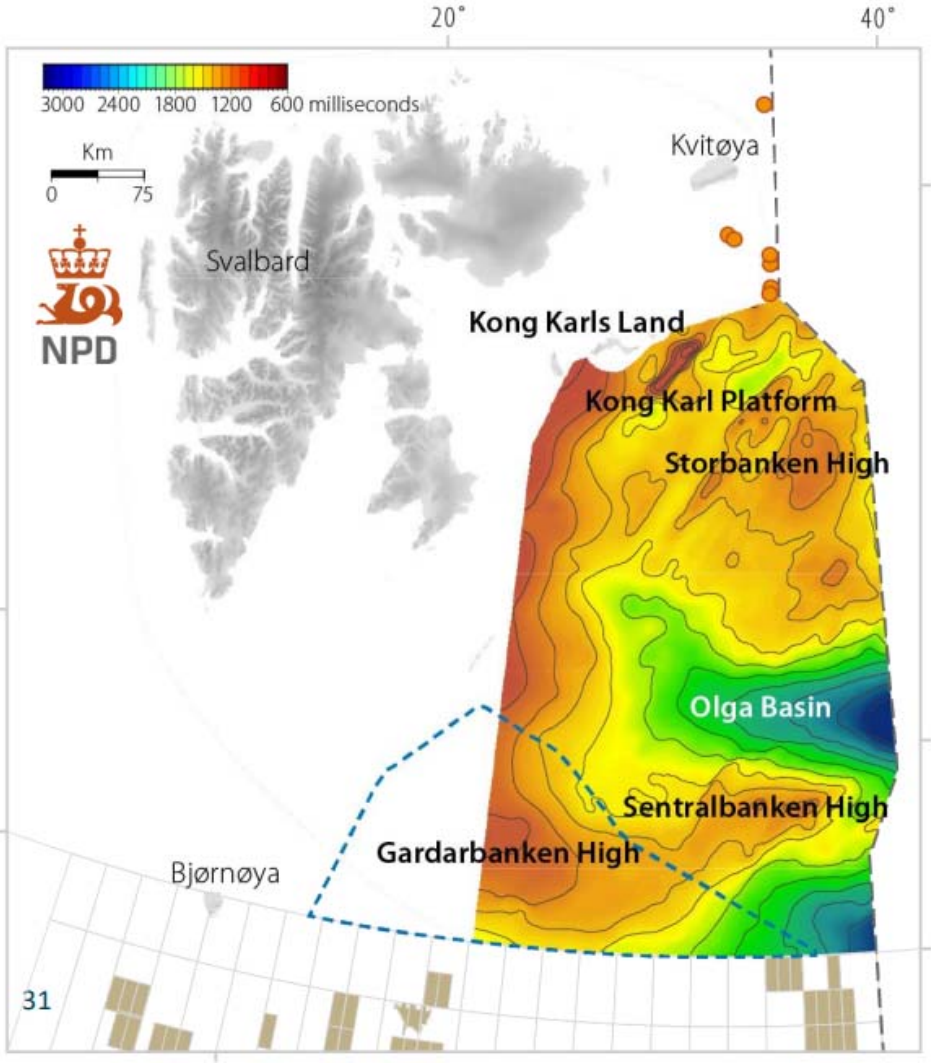
Summary and epilogue

- Svalbard is a window to the Barents Shelf geology
- Oil exploration in Norway started in Svalbard, with first drilling in 1961. An intense «oil-rush» occurred in the 1970s, and 18 wells were drilled
- It appears unlikely that conventional petroleum accummulations will be targeted in future onshore Svalbard. Unconventional shale gas, however, could be produced for local use



Acknowledgements and further reading

Senger, K., Brugmans, P., Grundvåg, S.-A., Jochmann, M., Nøttvedt, A., Olaussen, S., Skotte, A. & Smyrak-Sikora, A. in press: Petroleum, coal and research drilling onshore Svalbard: a historical perspective. *Norwegian Journal of Geology*

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