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

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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.

References Cited

Brugmans, P.J., 2008, Oljeleting på Svalbard; en glemt del av Norsk oljehistorie (Oil Exploration on Svalbard: A Forgotten Part of Norway’s Oil History) [in Norwegian]: Store Norske Spitsbergen Kulkompani, 349 p.


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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?

Source: NPD.no
Norwegian oil industry

- Ekofisk (1969, 1971)
- Statfjord (1974, 1979)
- Gullfaks (1978, 1986)
- Oseberg (1979, 1988)
- Åsgard (1981, 1999)
- Snøhvit (1984, 2007)
- Johan Sverdrup (2010)

Source: norskpetroleum.no
• Two fields – Snøhvit and Goliat
• Discoveries to be developed
• Sub-commercial discoveries
• Ca. 120 exploration wells

Source: Jakobsson (2018)
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.
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
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

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

Dallmann et al. (2015)
Claiming land in Svalbard

- Prospecting license (valid for 2 years)
- Date of marking of discovery
- Claim application date
- The claims are final six months after they have been proclaimed
- First period of obligatory work begins 1 October
- First period of obligatory work ends 30 September
- 2 years
- 5 years
- 2 years
- 6 months
- 4-5 years
- 5 years
- 5 years and so on

- Written notice to DMF on the discovery (Discovery Notice)
- The claims proceedings are completed within 2 years of the application date
- 4 years after 1 October in the year after the claims are made final the first period of obligatory work begins
- 1500 man days of work must be completed on each claim in this period
- Second period of obligatory work begins 5 years after the first
Claiming land in Svalbard

-2 -1 0 1 2 3 4 5 6 7 8 9 10

Time (years)

Prospecting license (valid for 2 years)

Date of marking of discovery

Claim application date

The claims are final six months after they have been proclaimed

2 years

5 years

2 years

4-5 years

10 months

Written notice to DMF on the discovery (Discovery Notice)

The claims proceedings are completed within 2 years of the application date

(B) Søkeseddel

Innehaveren av denne søkeseddel for Svalbard

Aabjern Skotte

6351 Uppen

nasjonalitet Norsk

fullmakttig

tidspunkt

meddeles herled adgang til for en tidrum av 2 -- to --
de fra idag d forsta søknng etter naturlige forekomster
av de i Bergverksordningen for Svalbard nemis: kull,
jerfjellet og andre mineraler och bergarter.

Tillatelsen gis med de rettighetene, med den begrensning
og med de forpliktelser som er fastsatt i normen Bergverk-
orden.

Søkningsstillatelsen gjelder for:

Svalbardøygurpan med de enkelte syers
territorialarfarn och med de begrensningar
som følger av lover och bestemmelser som er
fastsatt för øygruppen.

Longyearbyen, den 19. juli 1985

Johannesen Vik
Bergmester for Svalbard
Claiming land in Svalbard
Claiming land in Svalbard
Claiming land in Svalbard
Claiming land in Svalbard

Svalbard land area in 2017
(total = 61 020 km²)

- claimed area (6%)
- area not protected or claimed (29%)
- 7 national parks (24%)
- 21 nature reserves (41%)
Early exploration efforts - 1920

(A) A person is digging in the ground.

(B) A group of people is gathered around a tripod and a large pot, possibly for cooking or research purposes.
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

Ishøgda (1965)

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

Foto: Birger Angell
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

Foto: Svein Ytreland
Exploration drilling: Phase II

Hopen-II (1973)
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

Vassdalen (ca. 1987)

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

Foto: Stig Onarheim

Tromsøbreen II (1987)
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)
A technical discovery – thanks to coal drilling
A technical discovery – thanks to research drilling
- Cover large part of the stratigraphy
- Important link between geophysical data and outcrops
- Correlation between onshore-offshore domains

Borehole synthesis

<table>
<thead>
<tr>
<th>Well Name</th>
<th>Location</th>
<th>Depth (m)</th>
<th>Interval (m)</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>7611/5-1</td>
<td>Saltangen</td>
<td>1234</td>
<td>54-67</td>
<td>Paleogene coal</td>
</tr>
<tr>
<td>7715/1-1</td>
<td>Vossdalen II</td>
<td>567</td>
<td>23-45</td>
<td>Paleogene coal</td>
</tr>
<tr>
<td>7715/1-2</td>
<td>Vossdalen III</td>
<td>456</td>
<td>34-56</td>
<td>Paleogene coal</td>
</tr>
</tbody>
</table>

**Open spaces:**

- Shallow stratigraphic boreholes

**Source/Sinks:***

- Shale
- Coal
- Clay
- Salt
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 subsequent 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)
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 accumulations will be targeted in future onshore Svalbard. Unconventional shale gas, however, could be produced for local use
Acknowledgements and further reading


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