



NORWEGIAN PETROLEUM
DIRECTORATE

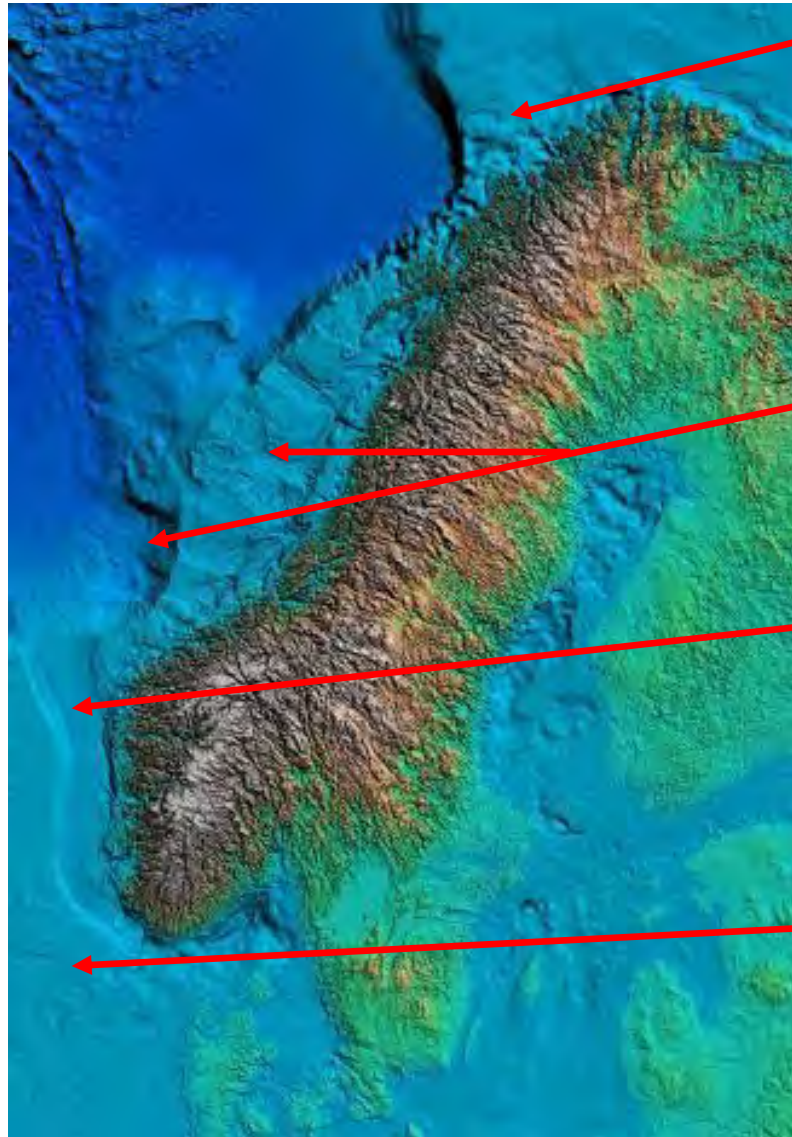


Basin analysis: the Norwegian Continental Shelf experience

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Norwegian Petroleum Directorate

The Norwegian Continental Shelf



Barents Sea

- proven resources mainly gas
- remotely from gas market
- less developed infrastructure
- moderate water depth (200-400m)
- environmental issues

Norwegian Sea

- mainly gas- & condensate fields
- deep water areas (300-2000m)
- environmental issues

Northern North Sea

- giant oil & gas fields
- well established infrastructure
- tail production and satellite tie ins
- moderate water depth (150-300m)

Southern North Sea

- giant oil fields (chalk)
- mature infrastructure after 40 years activity
- shallow water (70-150m)

Main roles of the NPD

- 1. Advisor** to the Ministry
- 2. Overview** of facts and communicate facts
- 3. Promote** realisation of full resource-potential
- 4. Develop framework and execute**
- 5. Follow-up** activity
- 6. Facilitate** efficient industry processes

Purposes of prospect evaluation by NPD




- ◆ Basis for recommendation for which blocks should be awarded and proposals for work commitment for licenses
- ◆ Basis for evaluation of applications for licenses or bidding rounds
- ◆ A state participation can be decided on basis of the evaluation carried out by the government in addition to the applicants/bidders




NPD public and free released material


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Petroleum resources off Lofoten, Vesterålen and Senja >>



Move cursor to points for links

Active exploration wells	
15/12-22	
25/1-11 R	
6407/2-6 S	
15/12-23	
2/2-6	
16/1-11	
6506/9-2 S	
1/3-12 S	
Overview - this year	
Updated 23.04.2010	

EXPLORATION DRILLING PERMITS

23.04.2010	6506/9-2 S
09.03.2010	34/5-1 S
27.04.2010	6608/10-1 S

PRODUCTION FIGURES

22.04.2010	February 2009
10.03.2010	January 2010
09.02.2010	December 2009

DRILLING PERMITS

21.04.2010	6507/5-6 S
31.03.2010	16/1-11 A
29.03.2010	6406/3-8

ONGOING SEISMIC

Guidance

Amendment proposed to the Resource Management Regulations - consultation

08.04.2010 The Norwegian Petroleum Directorate (NPD) is proposing amendments to the Regulations relating to resource management in the petroleum activities (the Resource Management Regulations).

Seismic surveys both increased and reduced fish catches

02.03.2010 Sound waves from seismic data acquisition resulted in increased catches for some species and smaller catches for others. It appears that pollack may, to some extent, have withdrawn from the area, w...

New Guidance Notes for border fields

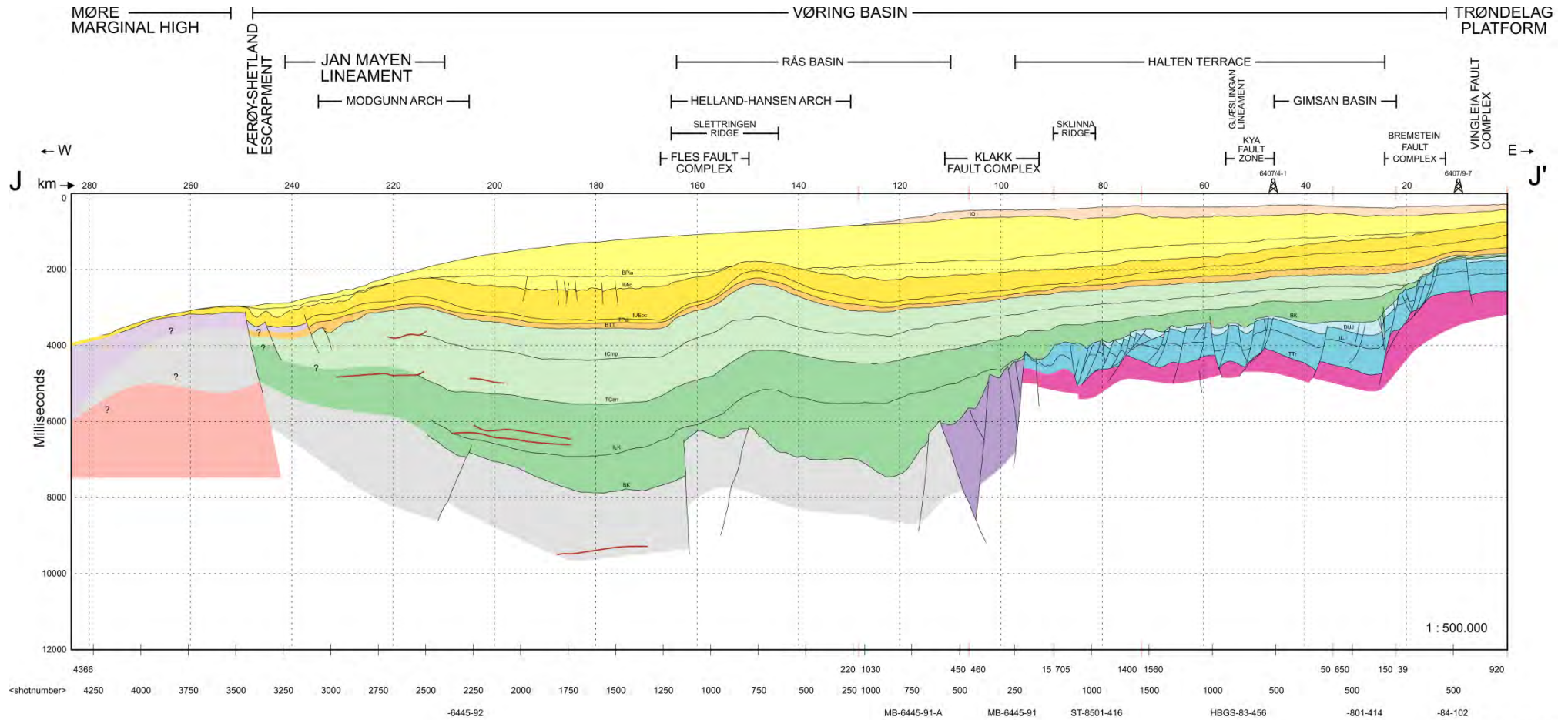
01.03.2010 The Norwegian and British authorities have prepared new Guidance Notes with the intention of

FactPages >

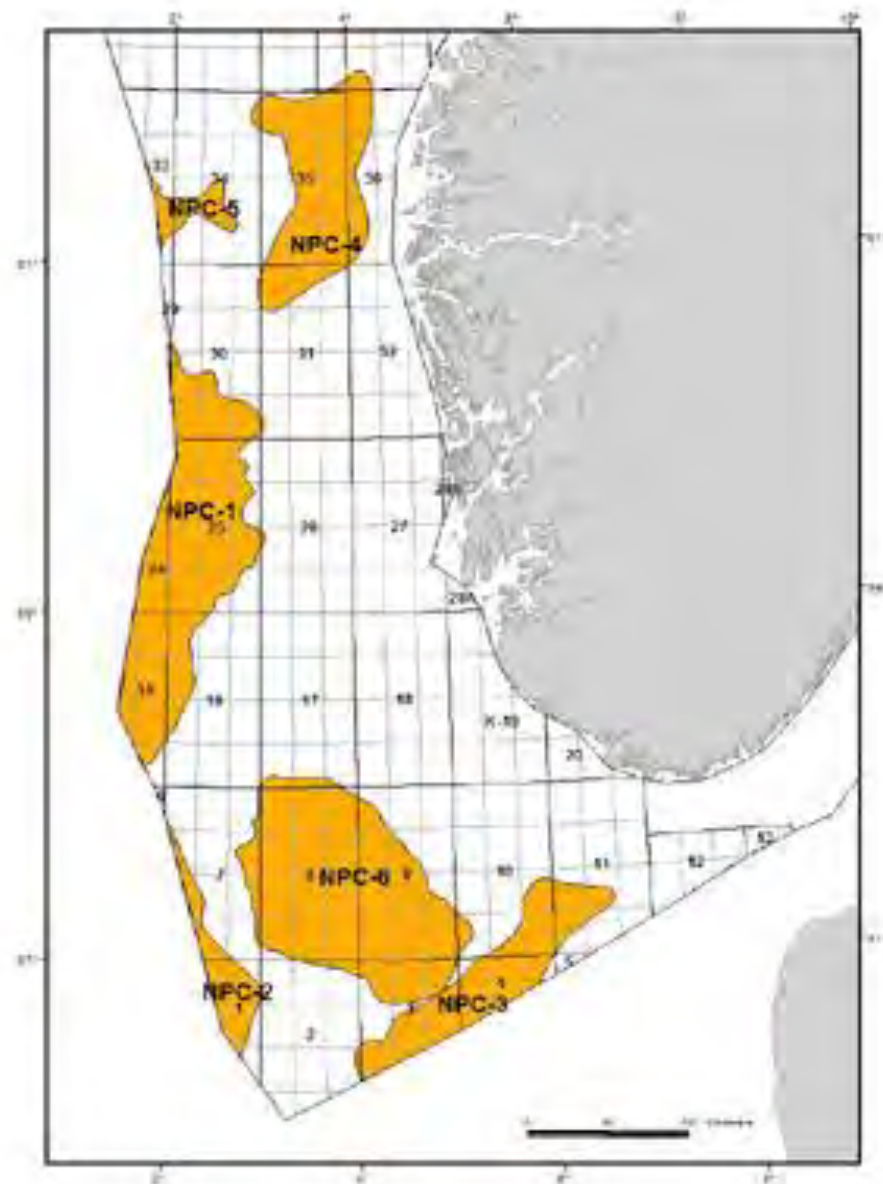
FactMaps >

ORDER NEW SHELF MAP

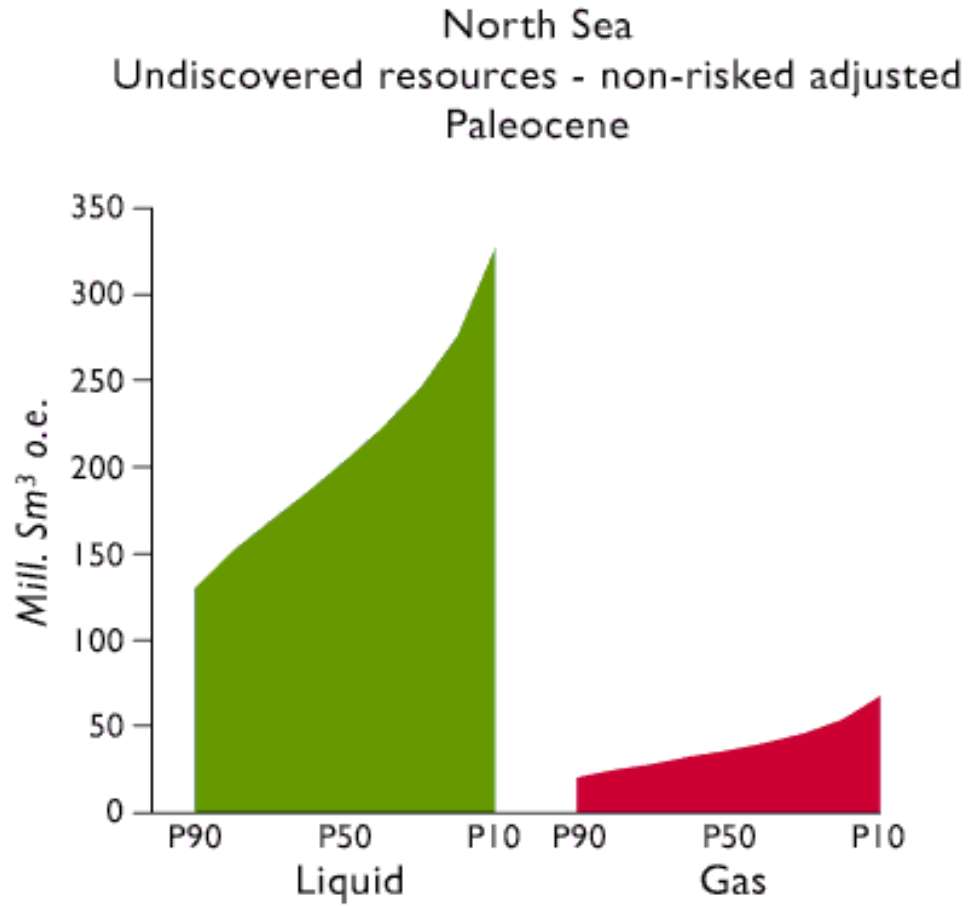
Haltenbanken - NPD



Exploration model for Tertiary



TERTIARY-QUA	EARLY / LATE	Pleistocene		
		Pliocene		
		Miocene		
		Oligocene		
		Eocene		
CRETACEOUS	LATE	Paleocene		
		Maastrichtian		
	EARLY	Campanian		
		Santonian		
		Coniacian		
		Turonian		
		Cenomanian		
		Albian		
		Aprian		
		Barremian		
Hauterivian				
Ryazanian				
JURASSIC	LATE	Volgian		
		Kimmeridgian		
	MIDDLE	Oxfordian		
		Callovian		
		Bathonian		
		Bajocian		
		Valenian		
		Toarcian		
		Puenzbachian		
		Sinemurian		
Hettangian				
TRIASSIC	LATE	Rhätian		
		Notian		
	MID	Carriac		
		Ladinian		
		Anisian		
		Scythian		
		Tatavian		
		Kazanian		
		PERMIAN	LATE	Kungurian
				Artinskian
EARLY	Sakmarian			
	Asselian			
	Gzelian			
	Kasimovian			
	Moscovian			
	Bashkirian			
	Serpukhovian			
	Yrshai			
Tournaisian				
CARBONIFER.	LATE	Gzelian		
		Kasimovian		
	EARLY	Moscovian		
		Bashkirian		
		Serpukhovian		
		Yrshai		
		Tournaisian		
		Devonian		



OD0311012

Request for geochemical data and samples

How to obtain core, cuttings, oil samples and geochemical standards from the NPD

The NPD core store houses cuttings and conventional cores (no sidewall cores) from over 1000 wells on the Norwegian continental shelf. In addition, the Norwegian Geochemical Standard and more than 600 DST samples are stored.

Applications for core, cuttings and oil samples must contain:

A complete description of the investigation:

- Objectives (Why are you undertaking this study?)
- Methods (How are you going to achieve your objectives?)
- Time frame (preferred sampling date, project milestones, completion date)
- Distribution of results (journal article, thesis, non-exclusive report etc.)

Wells, intervals, sample type and amounts:

For example,

Well	Interval (m)	Sample type	Spacing	Amount
1/2-3	1200 - 1350 m	cuttings	apprx 15m	35 g
4/5-6	1950 - 2000 m	cores	apprx 5 m	20 g
7/8-9	2750 - 2800 m	oil	-	2 ml

Note: The entire project report for all studies carried out on NPD core and cuttings samples, must be given to the NPD upon project completion. This applies also for studies based only partially on NPD material. In addition, all thin sections, micropaleontological and palynological slides produced from NPD material, must be delivered to the NPD upon project completion.

Applications for Norwegian Geochemical Standard (NGS) samples must contain:

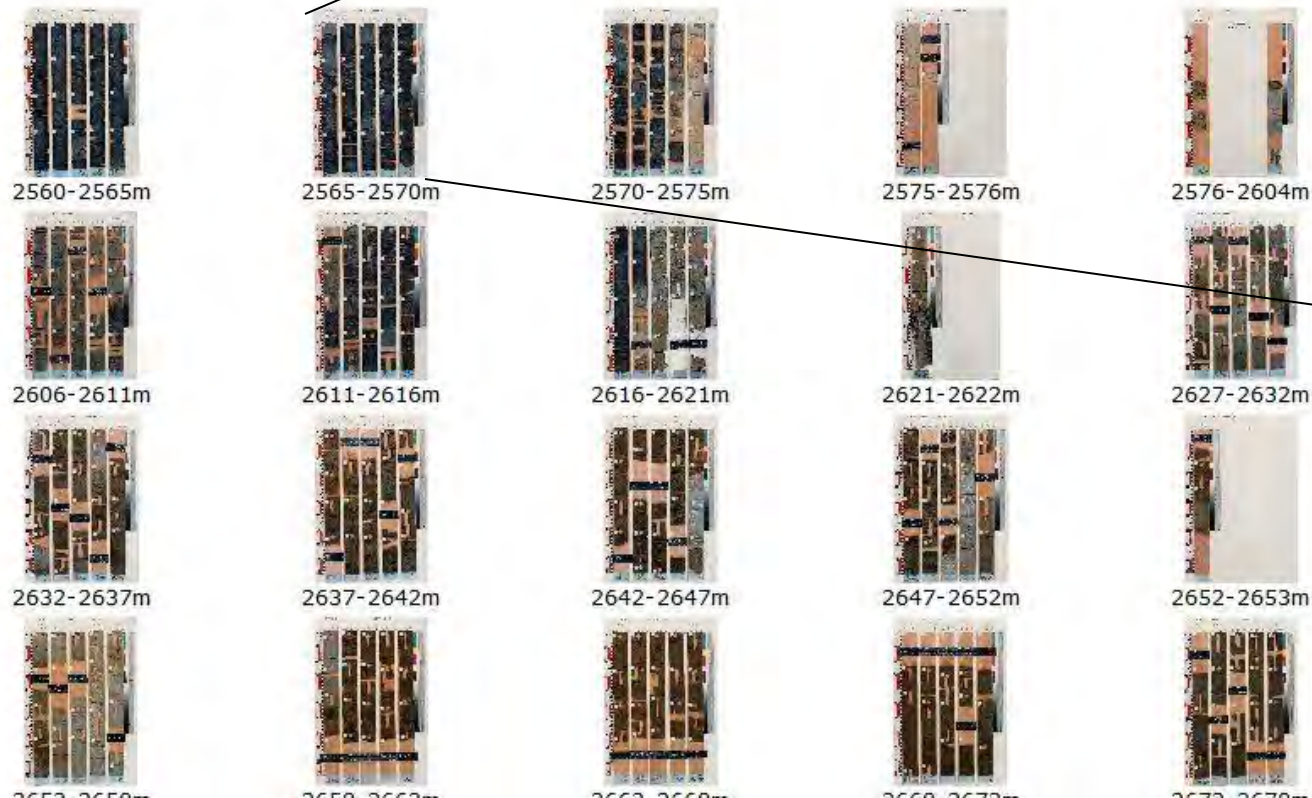
- Applicant's name, postal address, telephone and fax number, e-mail address, and a contact person.
- Description of the normal analytical activity of the laboratory (e.g. service laboratory for the oil industry, university laboratory working with environmental/geochemical problems, etc).

NPD core data and photos

Core number Interval

1	2560-2576.40
2	2576.40-2604
3	2604-2605
4	2618-2622
5	2627-2652.74
6	2653-2680.07
7	2680.07-2702
8	2702.96-2704
9	2705-2710.64
10	2710.64-2738
11	2738.64-2765

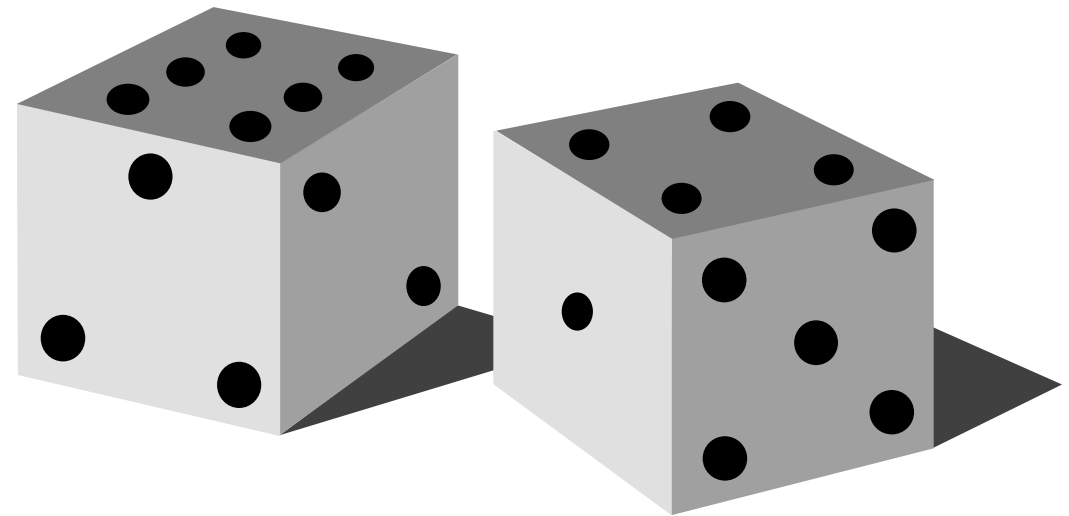
Scanned core photos



To make a discovery...

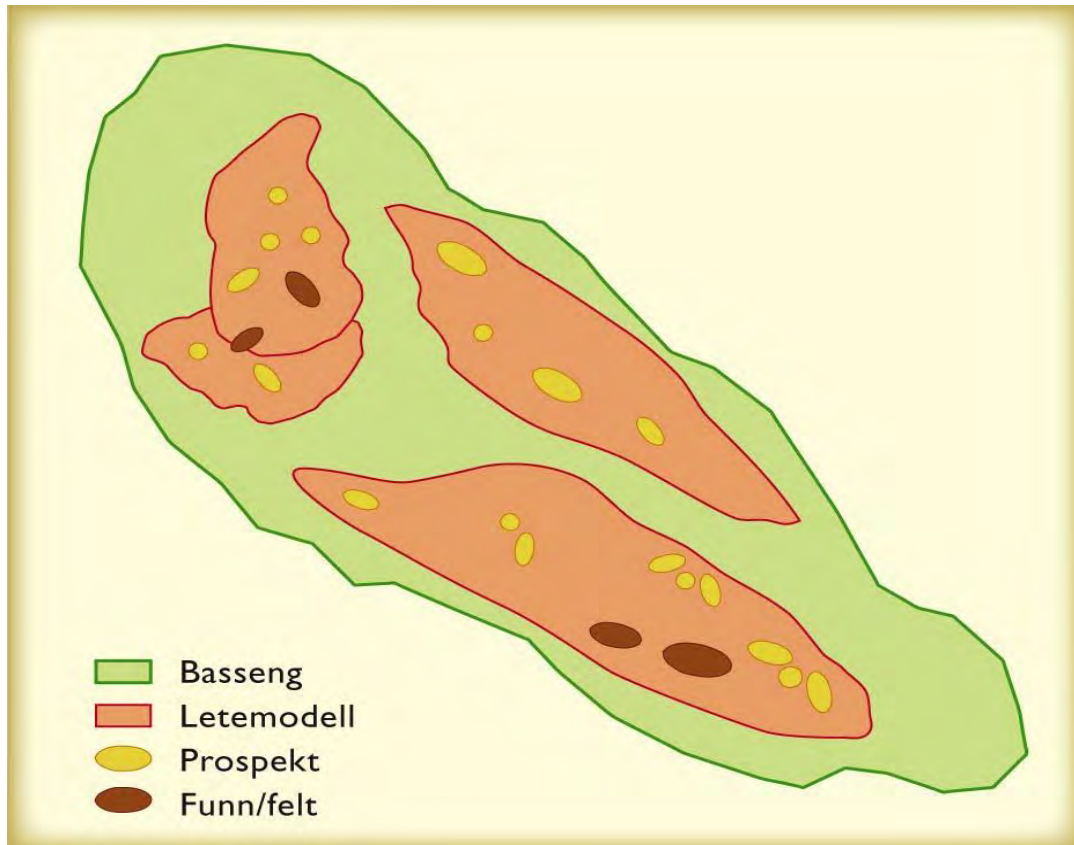
Play or prospect related probabilities:

- ✿ Reservoir
- ✿ Porosity
- ✿ Correct mapping
- ✿ Trap definition
- ✿ Mature source rock
- ✿ Migration into the trap
- ✿ Retention of HC in the trap

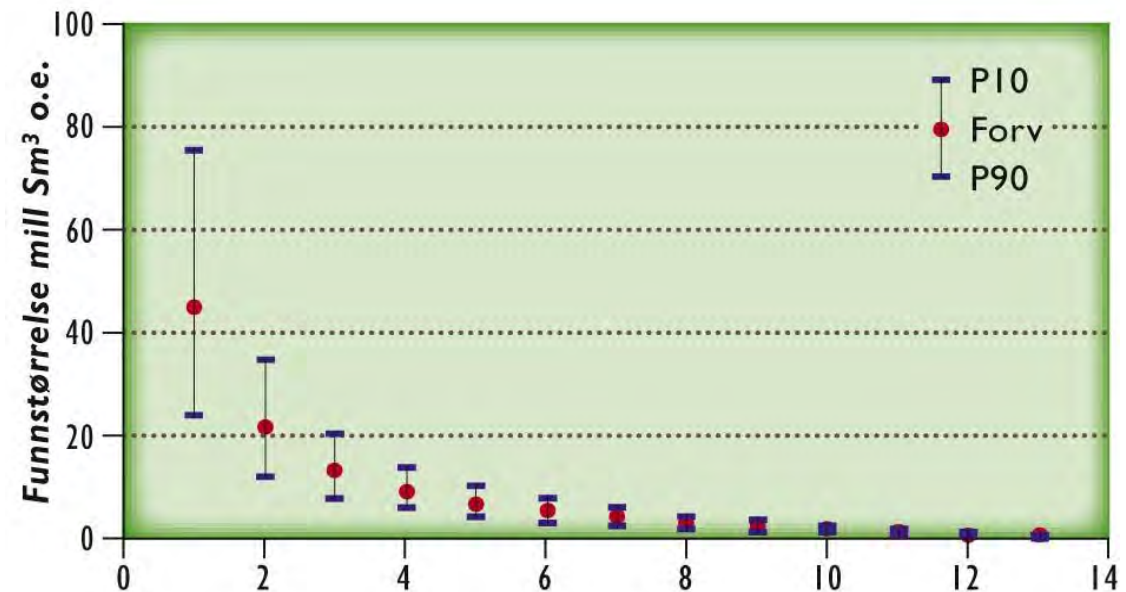


Exploration models and volumes

Basin, prospect and and plays



Statistics of basin plays

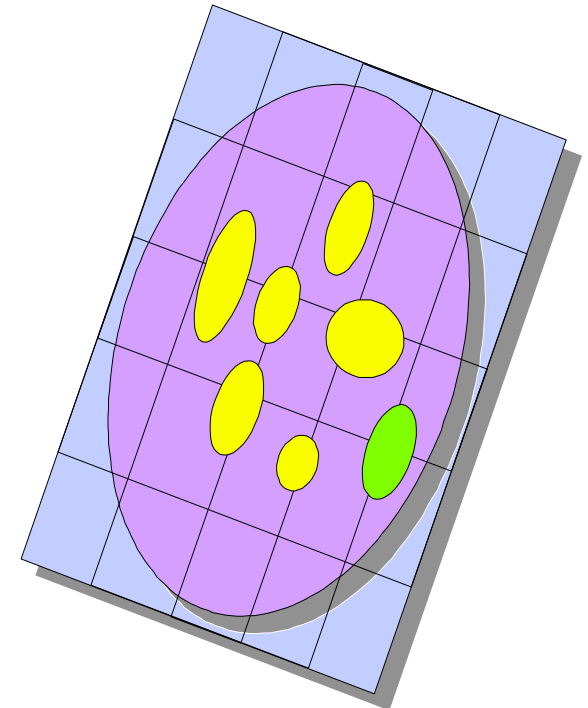


A basin contain exploitation models with prospects and plays

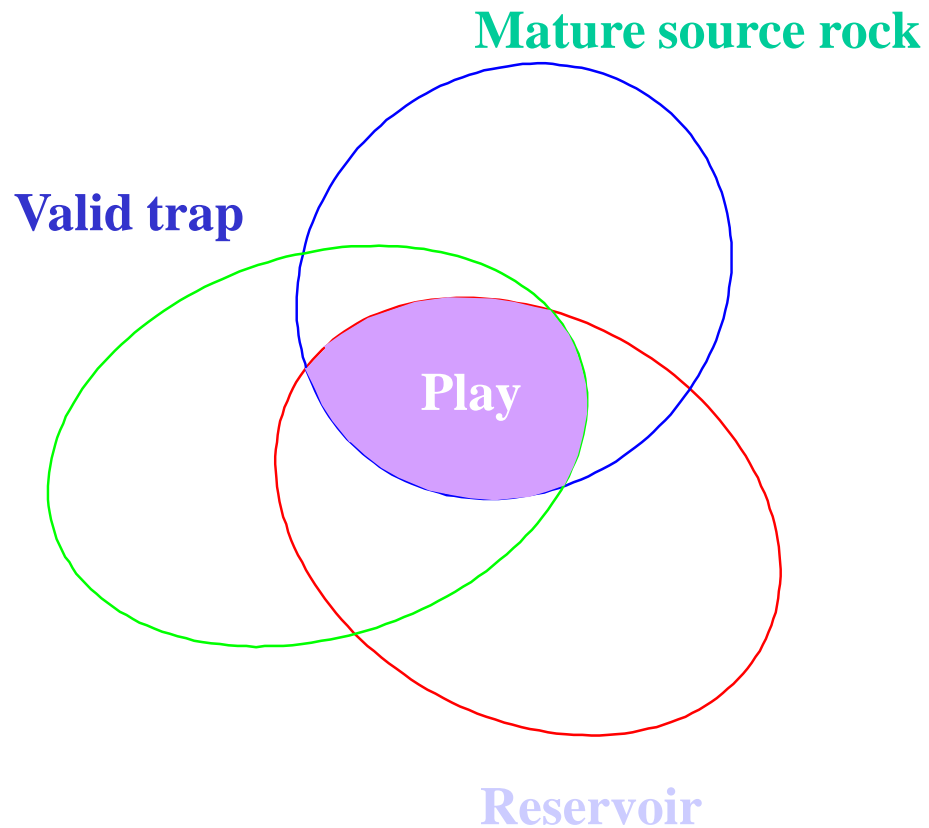
Play analysis

A group of prospects within a geographical limited area, which are defined by a common set of geological factors (efficient source rock, reservoir, trap type and seal).

- * **Confirmed plays; proved hydrocarbons**
- * **Unconfirmed plays; has not yet proved hydrocarbons**



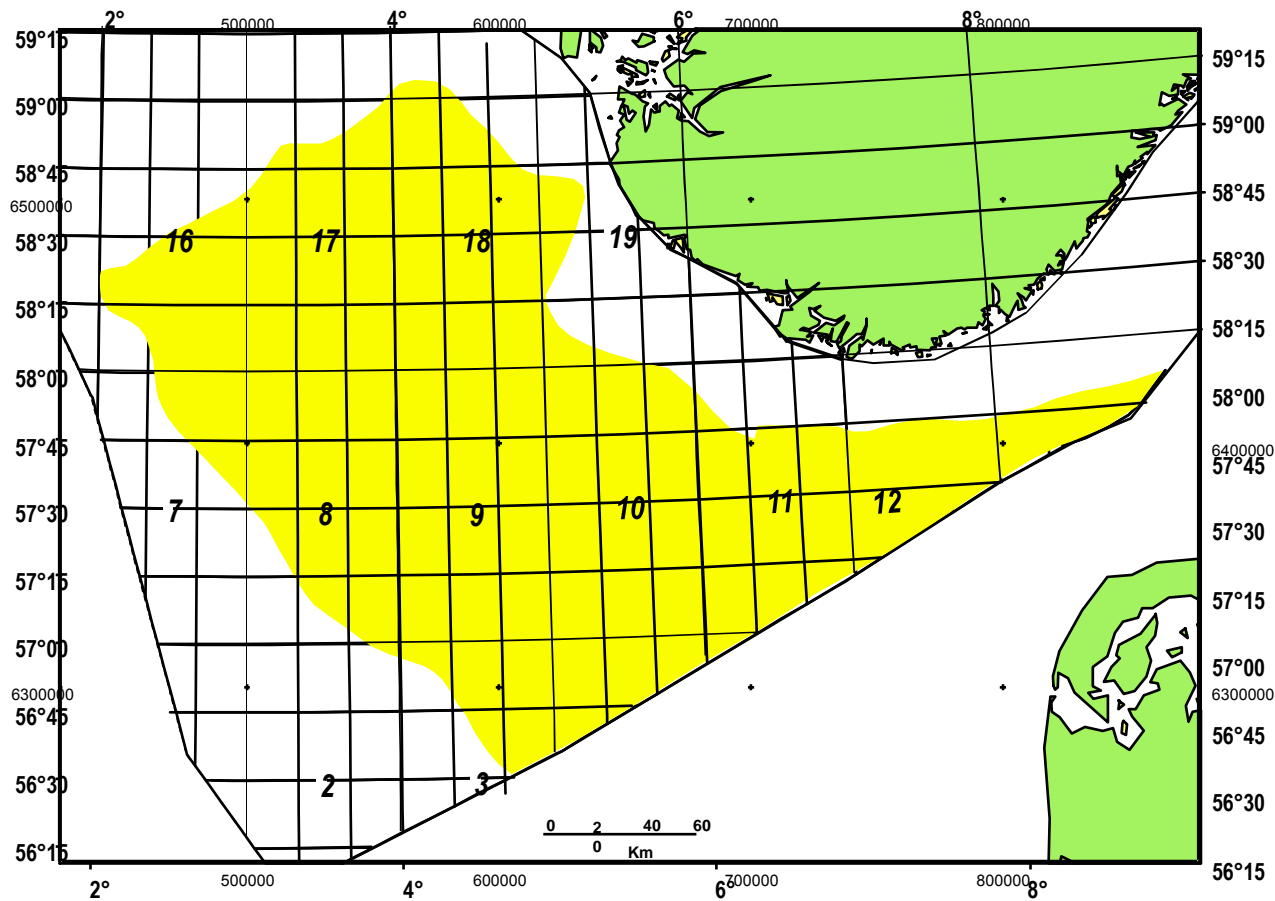
Play definition



Play criteria:

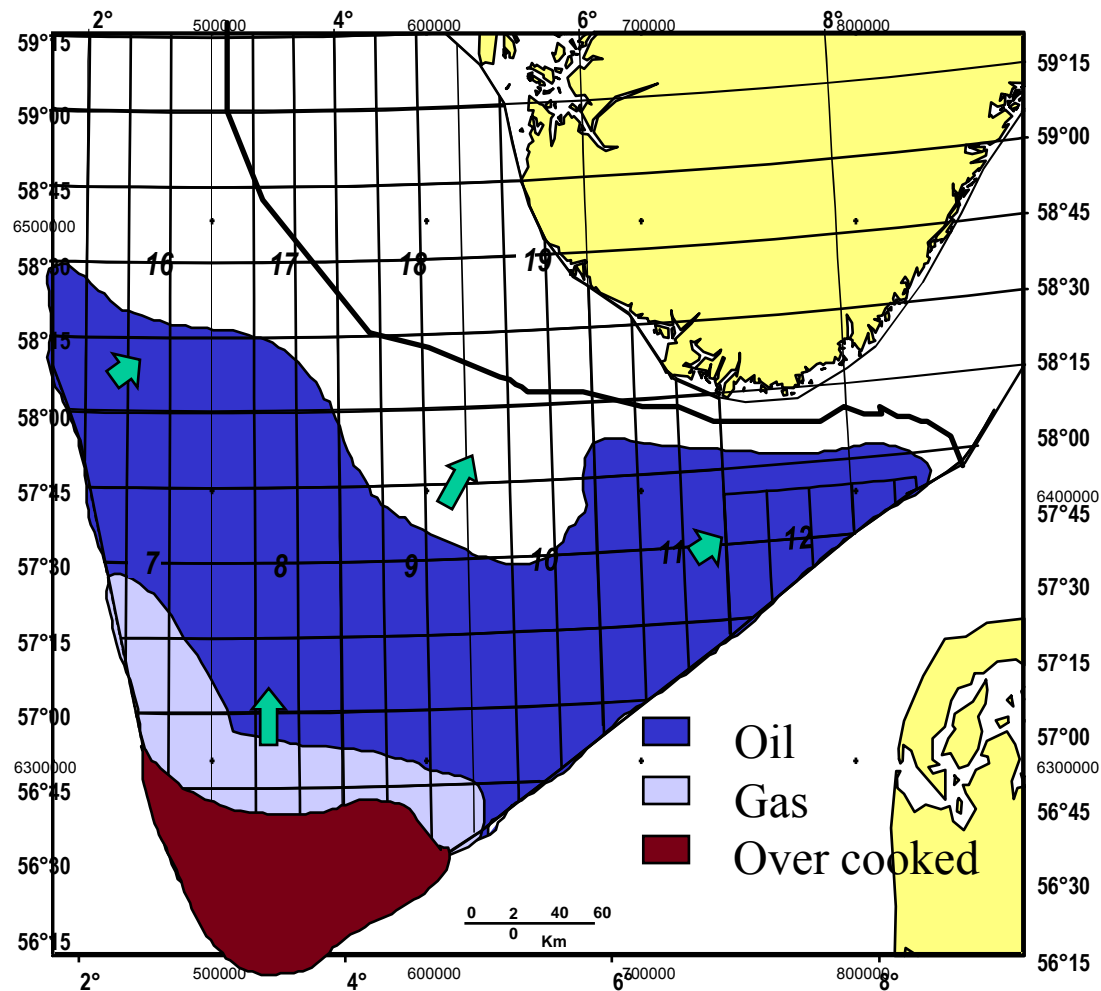
- Reservoir
- Mature source rock
- Migration
- Valid trap

Pre Jurassic reservoirs in the North Sea



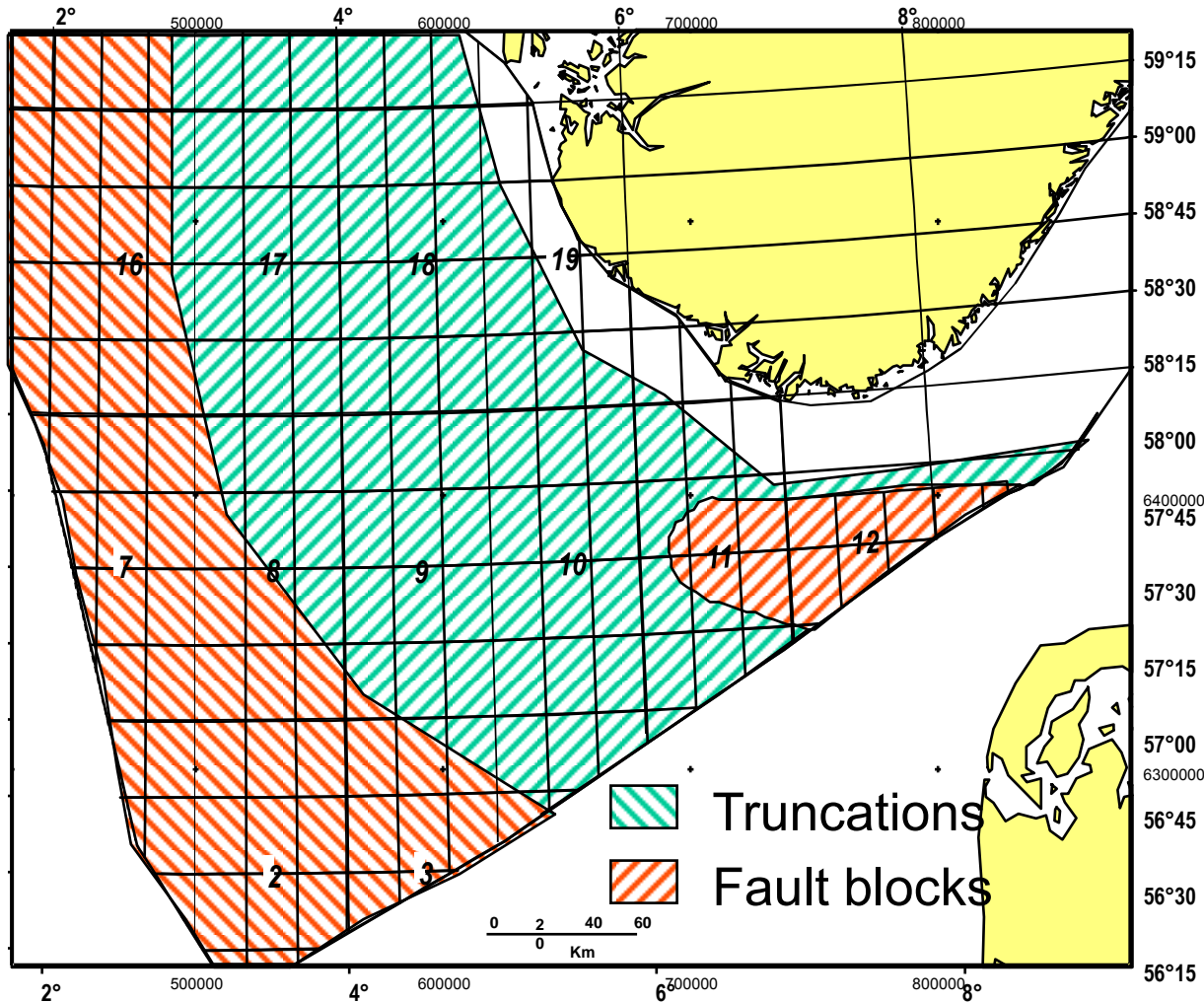
- depth
- diagenesis
- porosity
- cementation
- facies changes

Maturity map



- maturity
- volume
- migration routes
- timing

Trap map, Pre Jurassic play



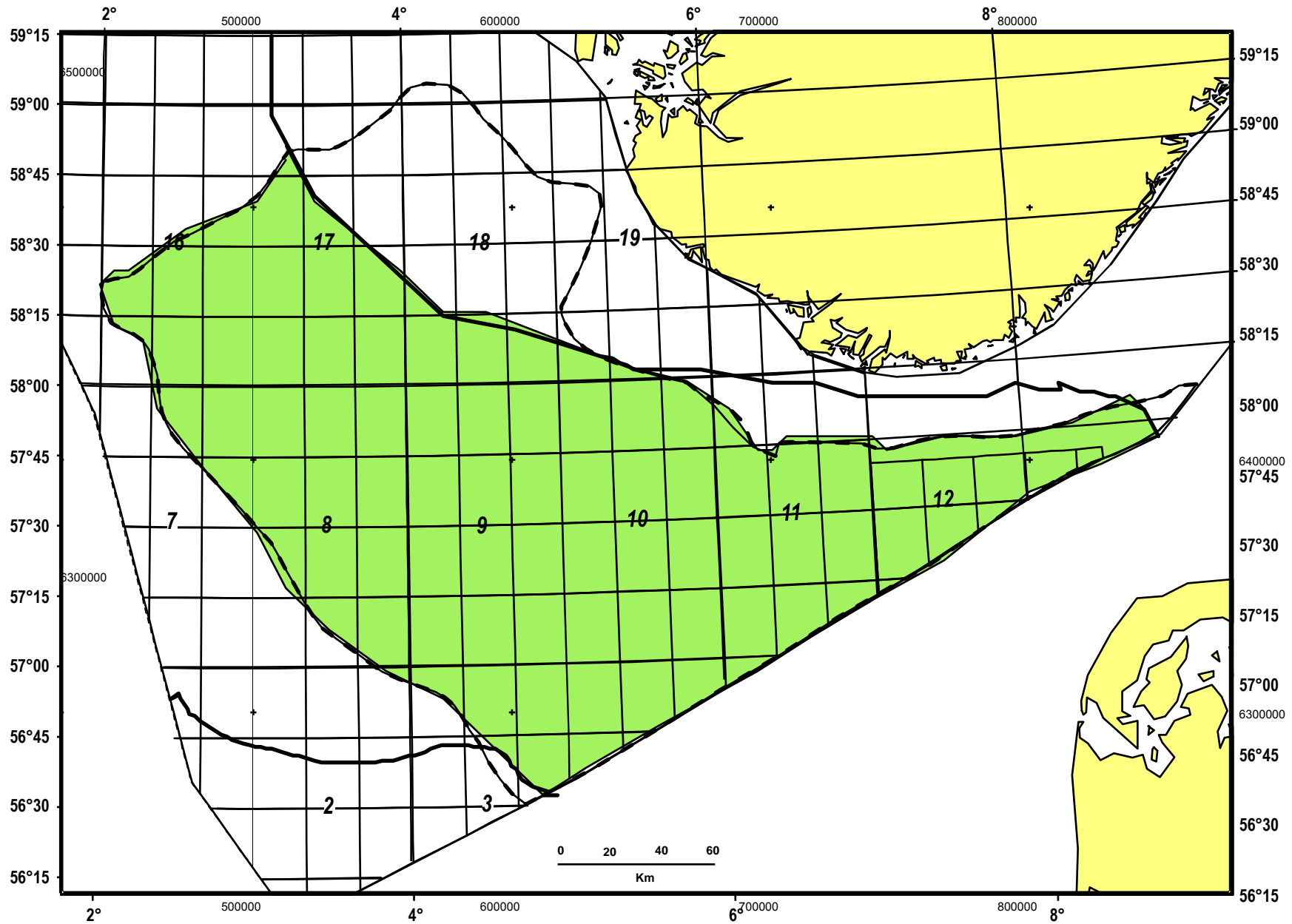
Structural traps, variation in tectonic impact

Stratigraphic traps, variations in depositional model

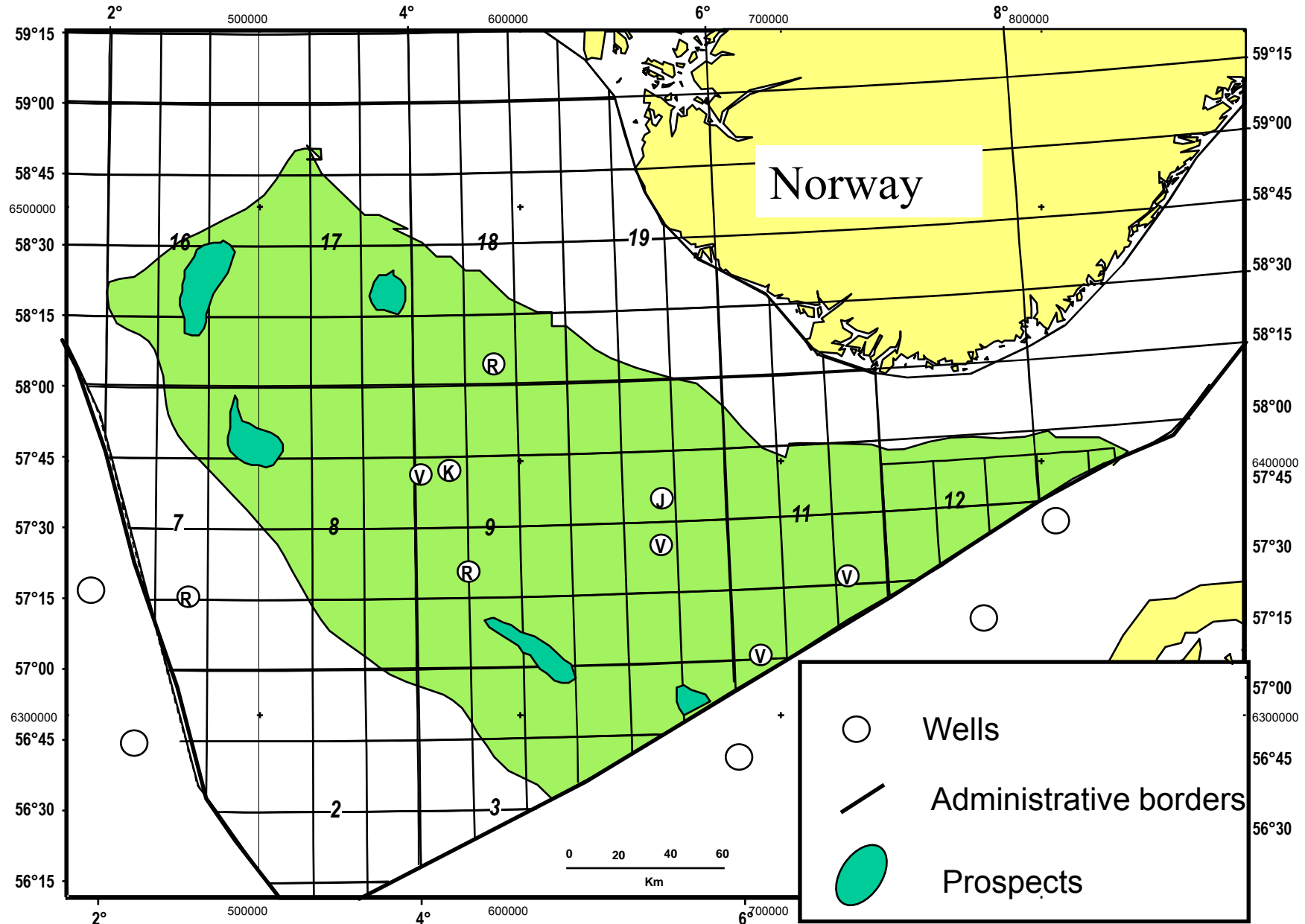
Changes in seal potential

Retention potential; HC phase and late uplift or tilting

Pre Jurassic play map



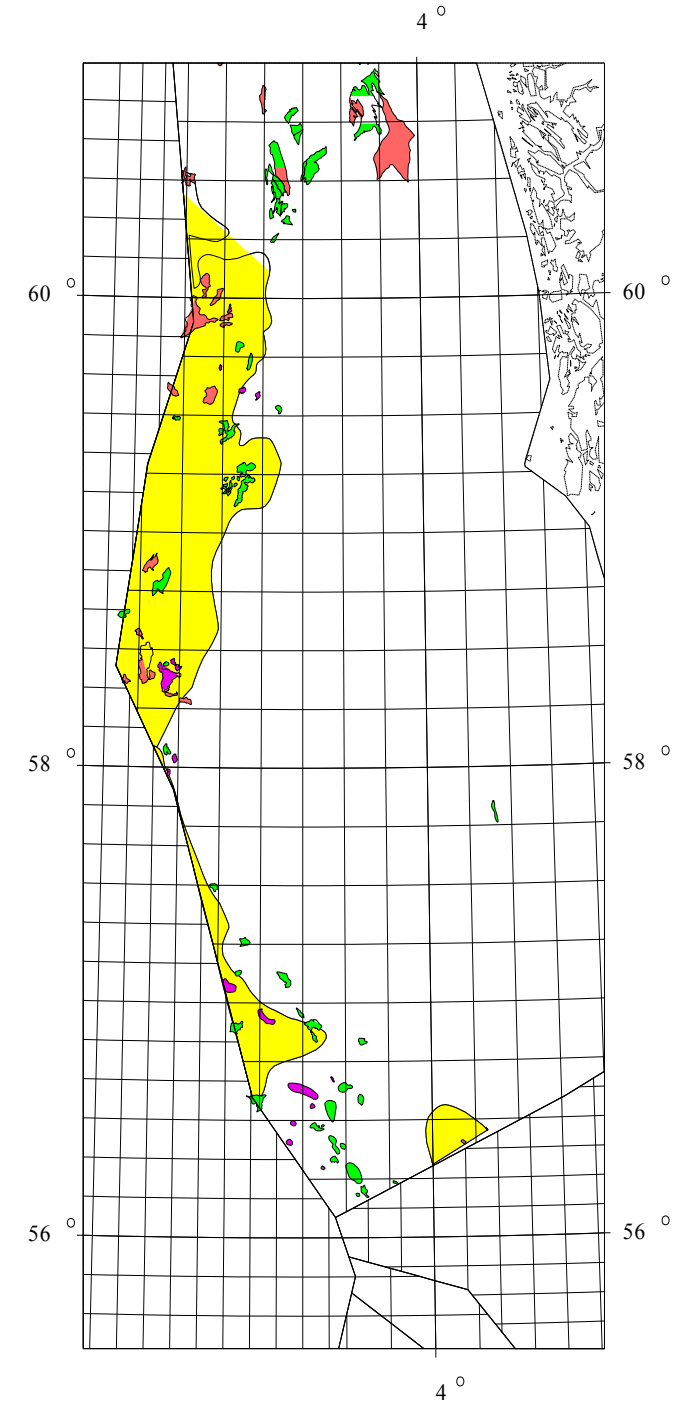
Experience map



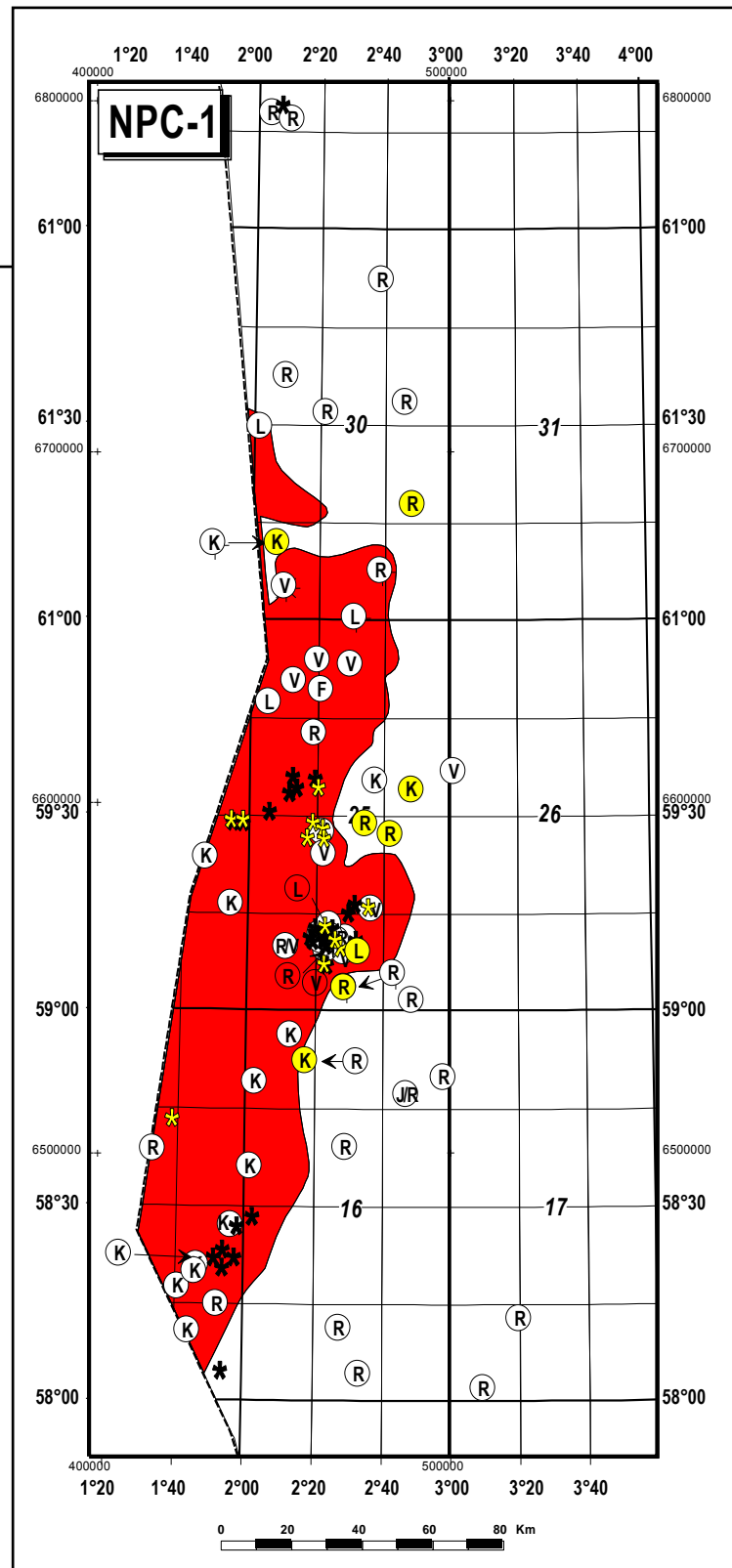
North Sea: Paleocene Play

Chronostratigraphy		Lithostratigraphy			Facies	
		Formation/Member (Fm/Me)	Lithology	Group		
QUATERNARY						
TERTIARY	PLIOCENE			NORDLAND	Pro - deltaic / deep - marine	
	MIOCENE	Upper	Utsira Fm		HORDALAND	Shallow marine erosion
		Middle				
		Lower				
	OLIGOCENE	Upper	Skade		HORDALAND	Sub - marine plains
		Lower				
	EOCENE	Upper	Grid		HORDALAND	Basin floor
		Middle				
		Lower				
PALEOCENE	Upper	Balder	Balder Fm	ROGALAND	Sub - marine fans	
		Hermod	Sele Fm			
	Lower	Heimdal	Lista Fm	ROGALAND		
		Ty	Våle Fm			
	Lower	Ekofisk Fm		ROGALAND		
CRETACEOUS	LATE	Maastricht	Jorsalfar Fm / Tor Fm	SHETLAND		
		Campan	Kyrre Fm / Hod Fm			
		Santon - Turon				
		Cenoman	Blodøks / Trygvason Fm / Svarte Fm			

RLS 9605046



Experience Map



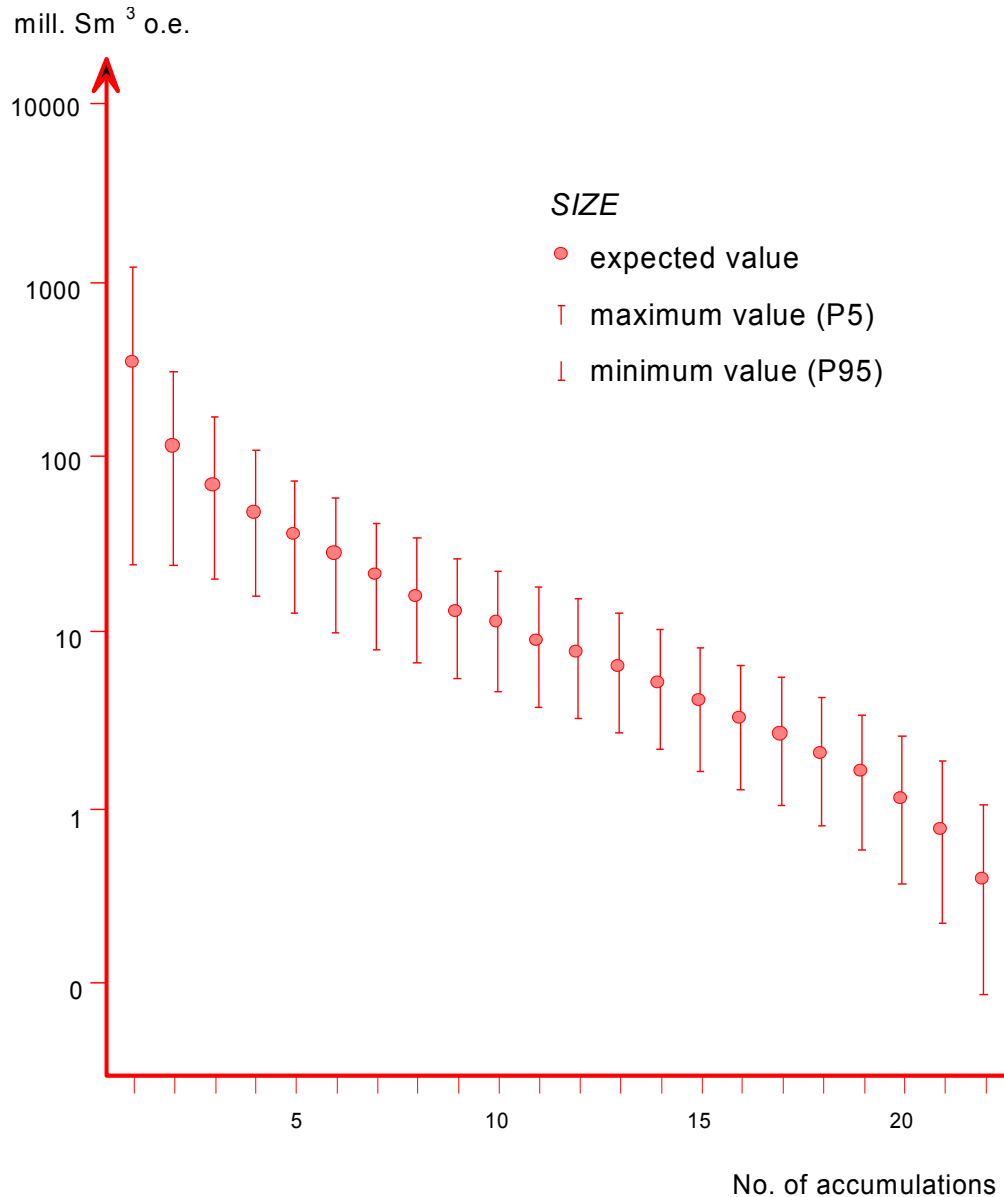
* **Success** (wildcat and appraisal wells)

o **Dry well**

Problem Legend

- ◆ R lack of reservoir
- ◆ K source / migration
- ◆ F seal (vert. or lat.)
- ◆ L outside trap
- ◆ V other

Estimated future discovery sizes



- **Number of accumulations**

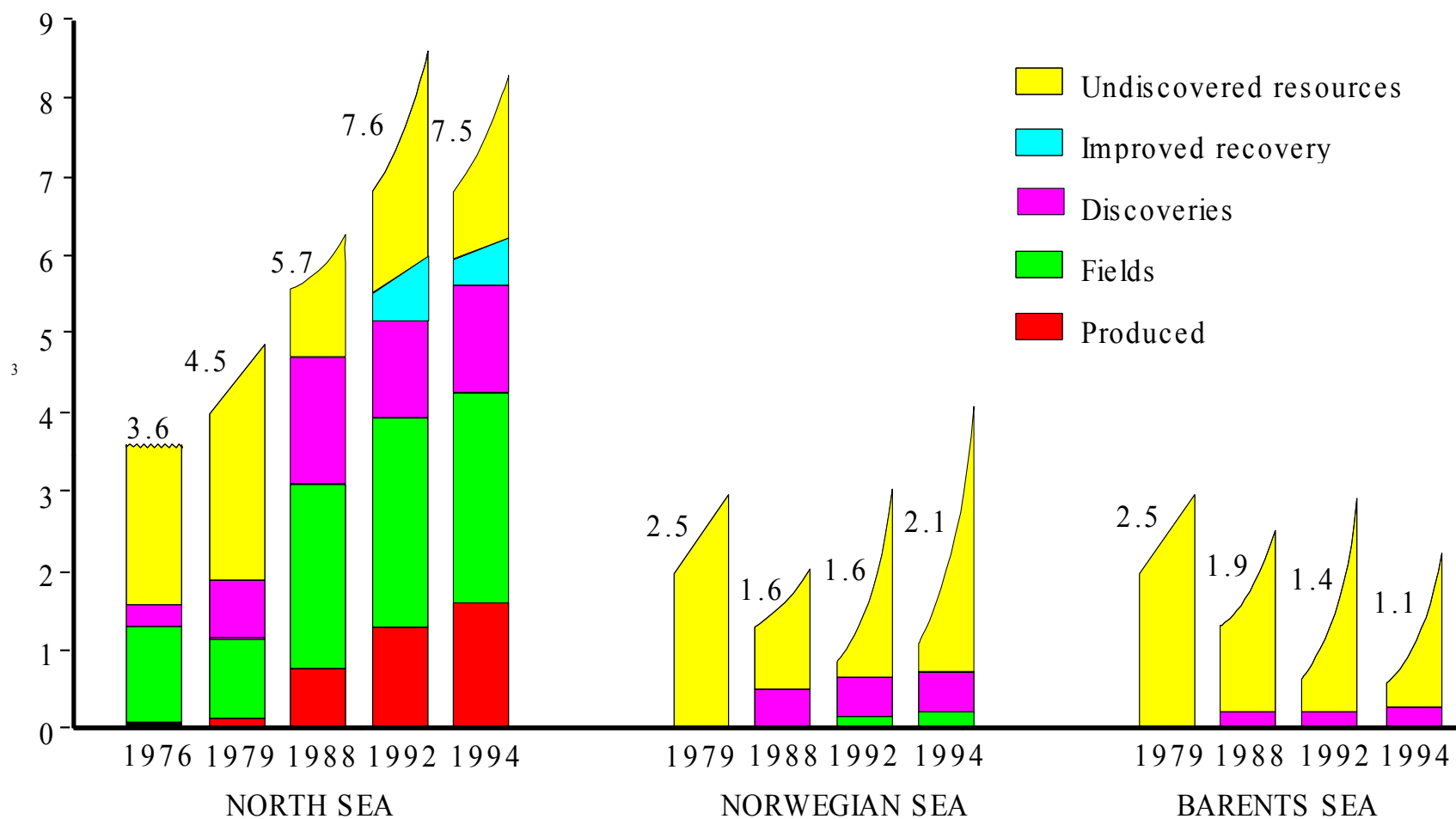
- **Sizes with ranges of uncertainty**

- **Confirmed versus unconfirmed plays**

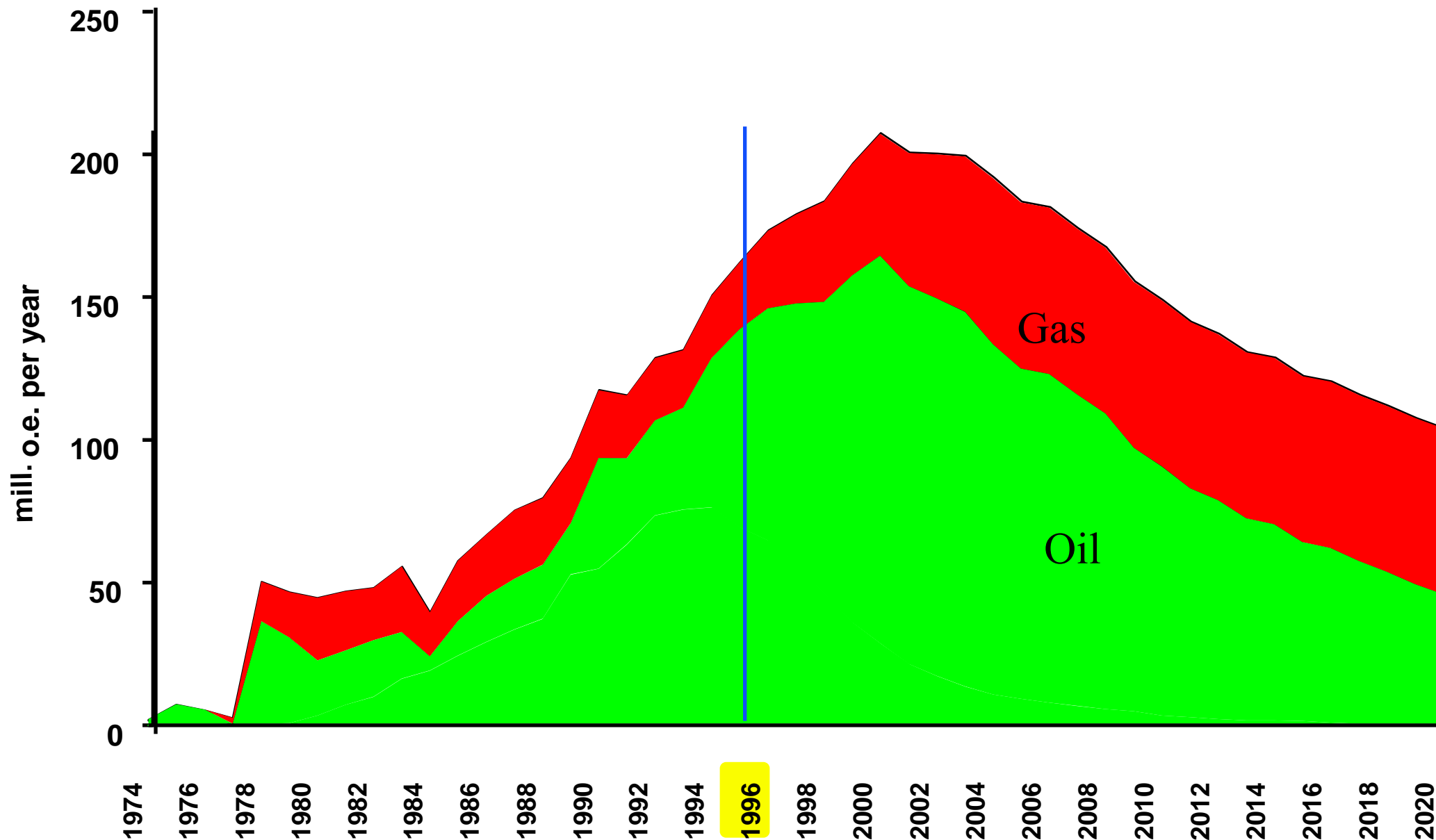
Previous and present estimates of total resources



Bill. Sm³ o.e.

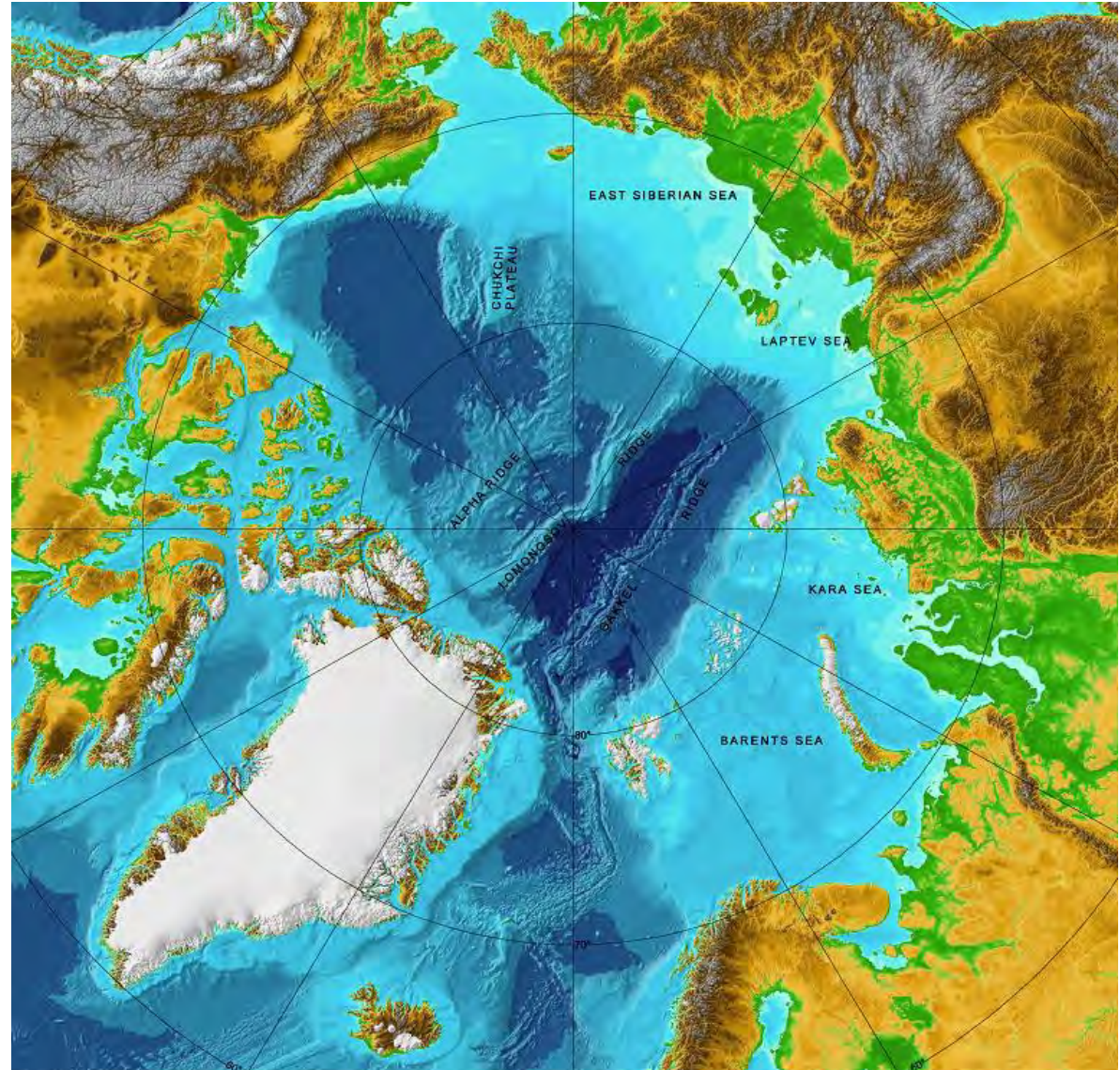


Production forecast

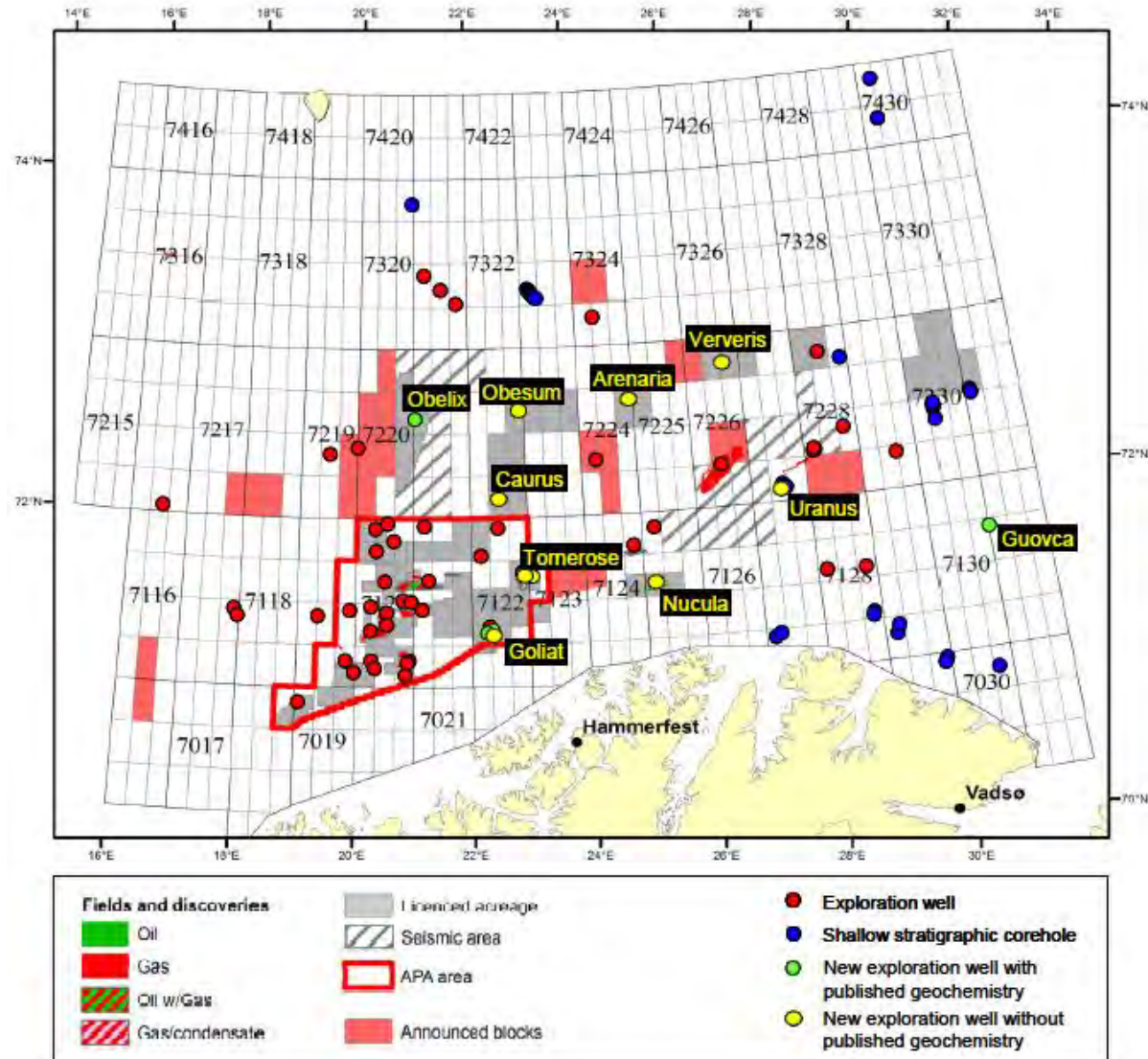


Exploration history of the Barents Sea

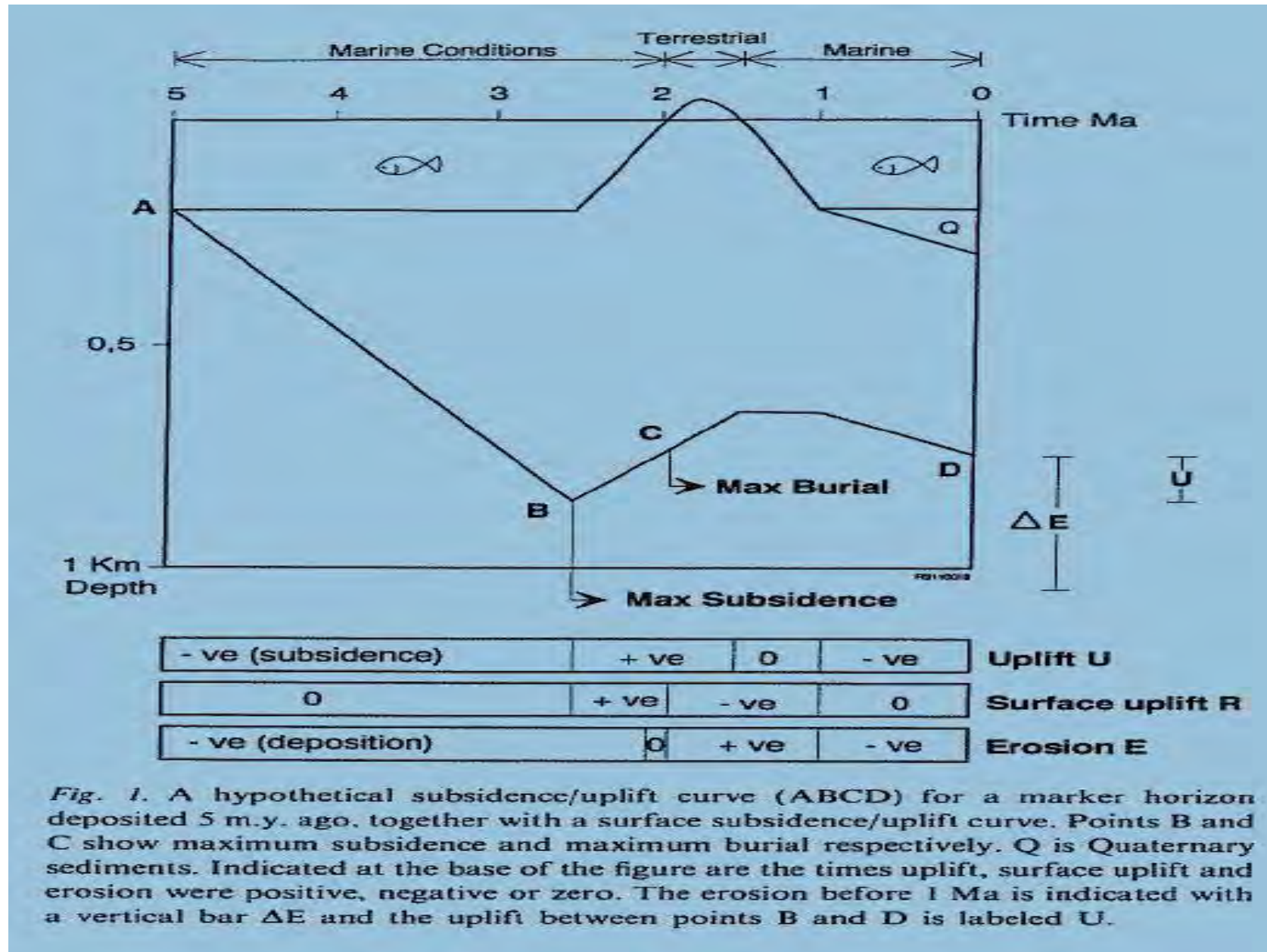
- ◆ Opened for exploration in 1980
- ◆ 66 exploration wells drilled
- ◆ First discovery 7120/8-1 Askeladd in 1981 (gas)
- ◆ Snøhvit discovered in 1984 (oil and gas)
- ◆ Goliat discovered in 2000
- ◆ Petroleum system proved in the Nordkapp Basin in 2001 (Pandora)
- ◆ Drilling results 2005 / 2006 positive related to pre-jurassic source rocks and reservoirs



Case study: Barents Sea



Case study: Barents Sea



Case study: Barents Sea

Source Rocks:

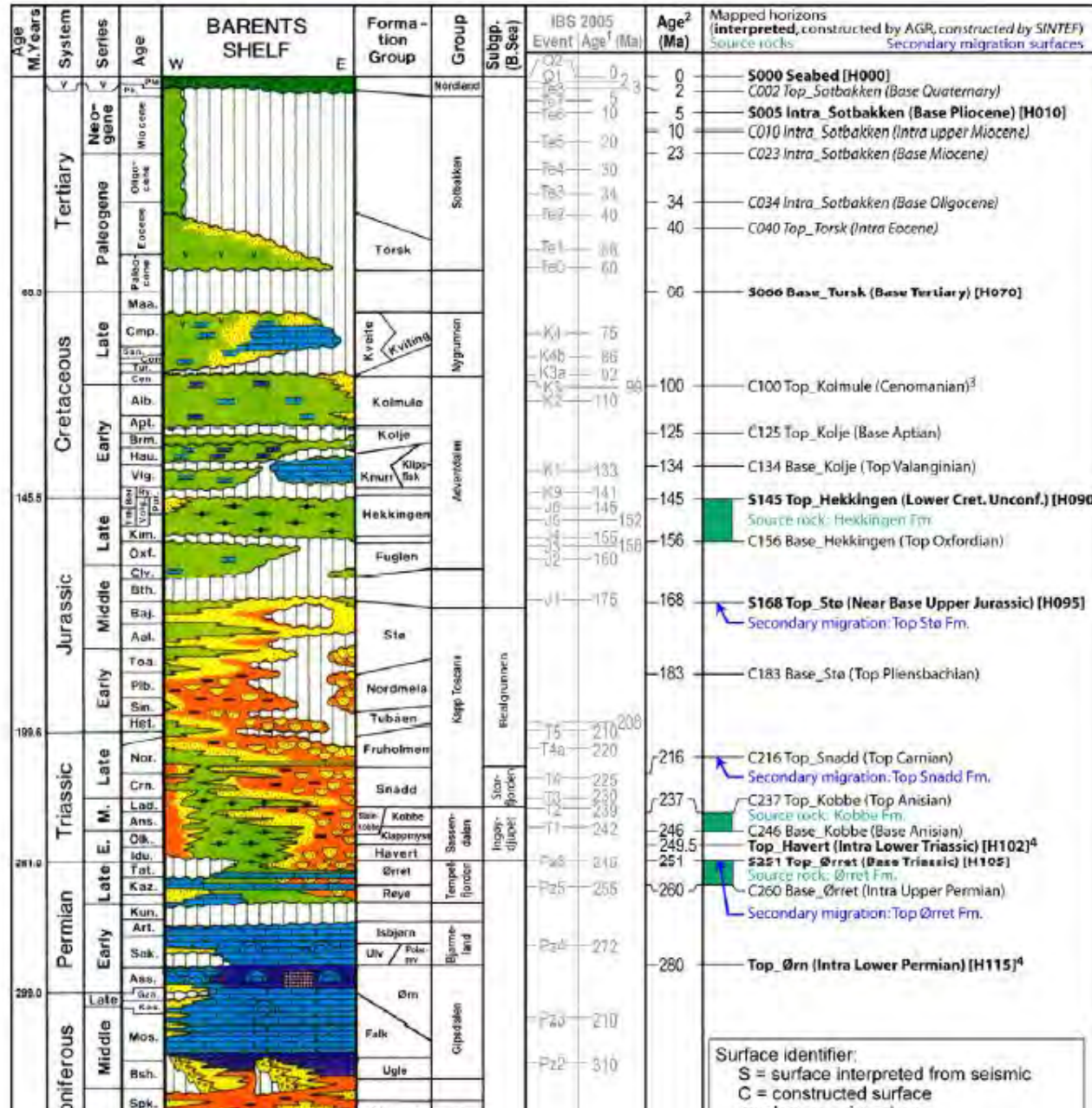
Hekkingen fm.: Distal marine, anoxic marine with some terrestrial. TOC 6-9%, 350-430 mg/g HI-potential.

Kobbe fm.: more variable and local distribution (where?), TOC up to 8%, HI to 480 mg/g.

Ørret fm.: only penetrated on few wells. Overmature.

Maturation, expulsion and secondary migration can be modeled.

Case study: Barents Sea sourcerocks



Case study: Barents Sea

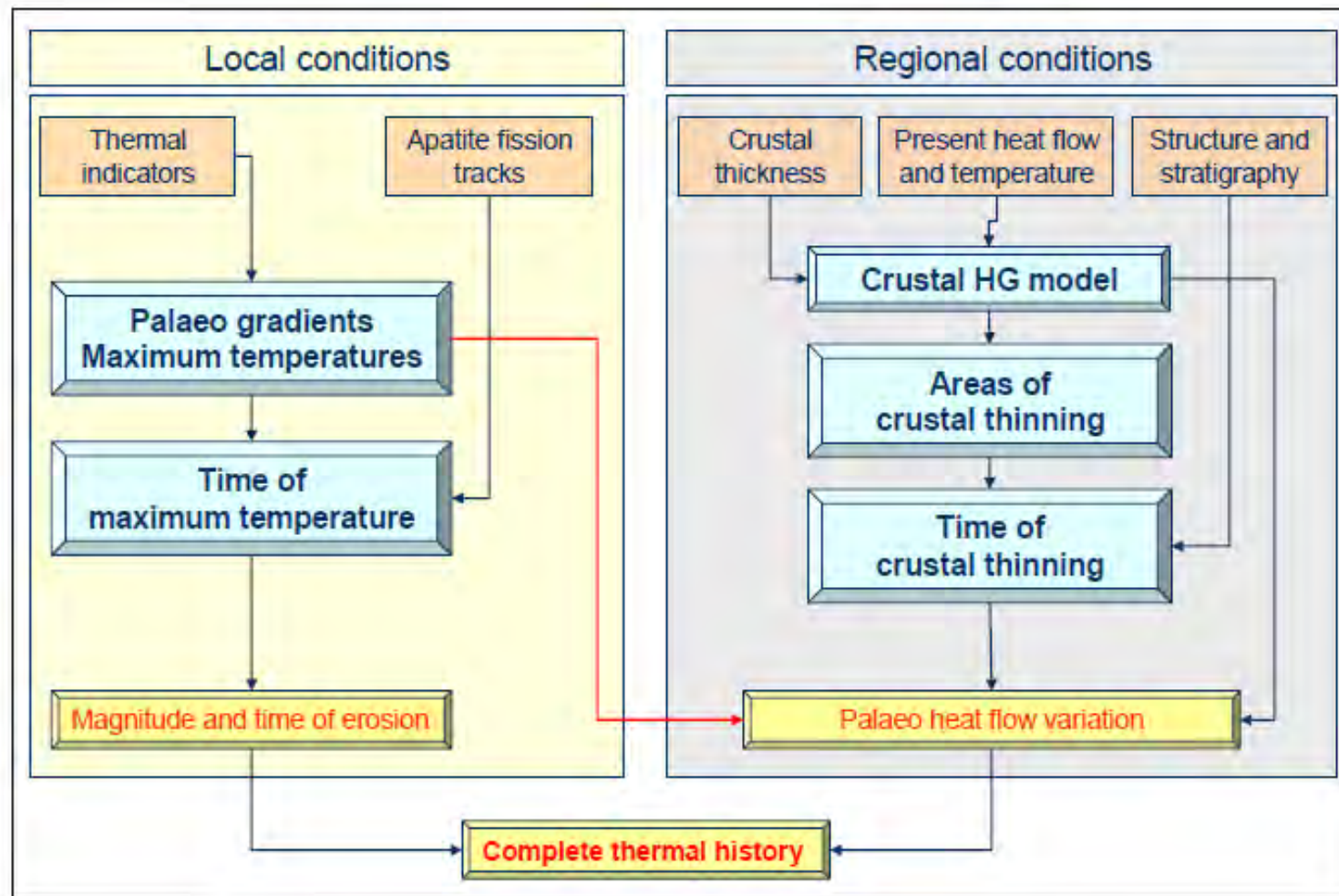


Figure 4.1 Work flow of thermal history investigation. HG model: Heat generation model.

Case study: Barents Sea SR thickness

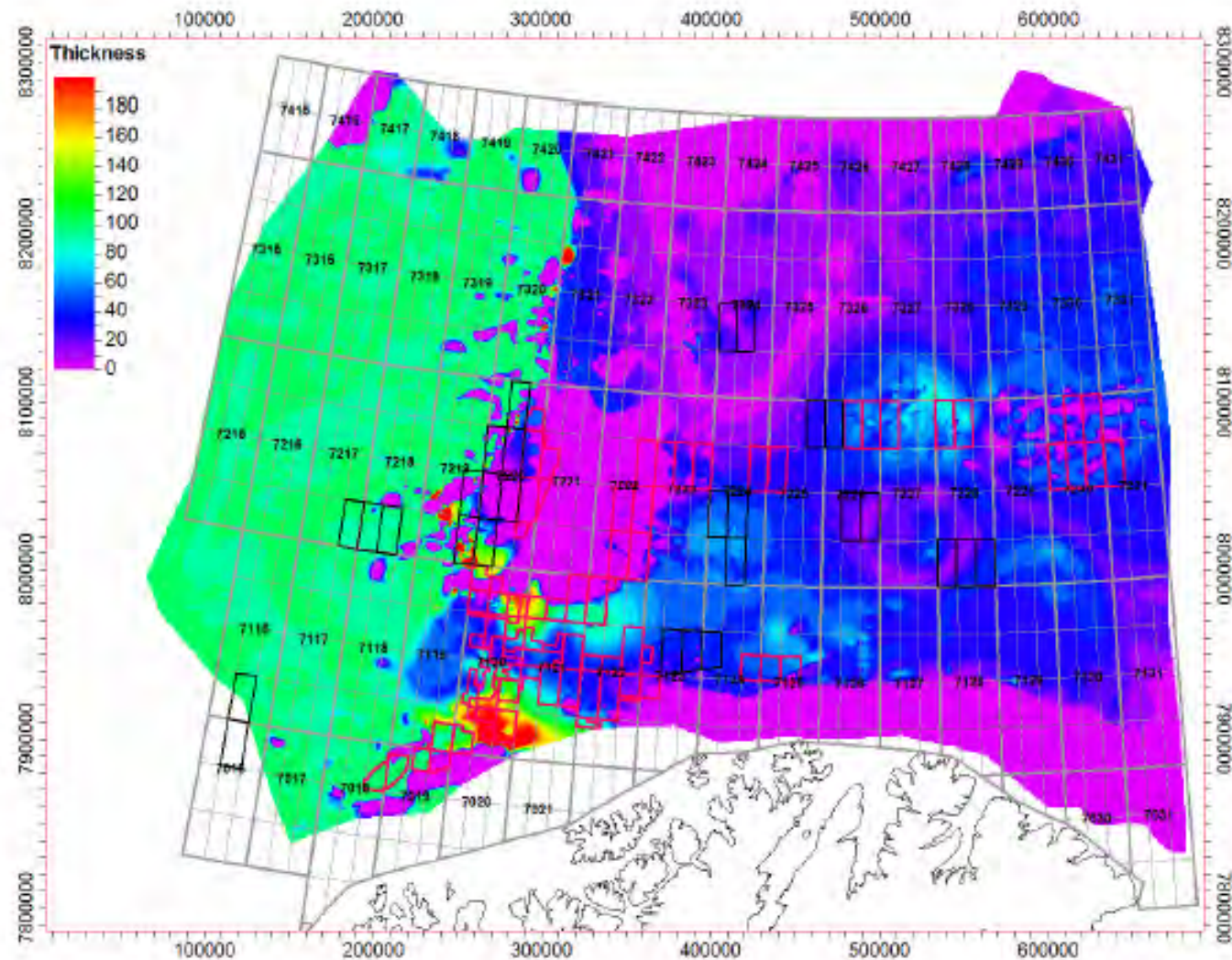


Figure 6.2 Thickness maps (m) of the Hekkingen Formation in the IBS 2005 (top) and the BMU 2008 (bottom).

Case study: Barents Sea scenarios

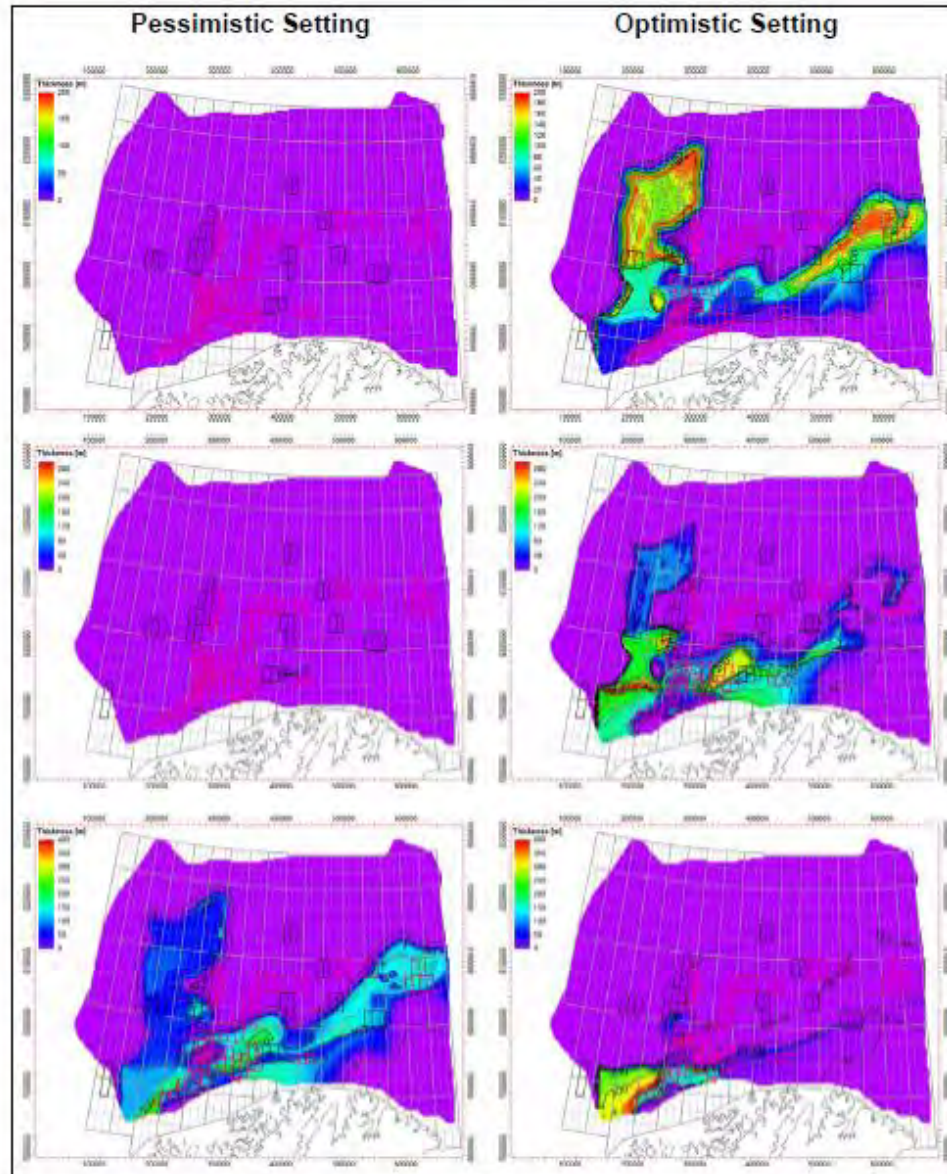
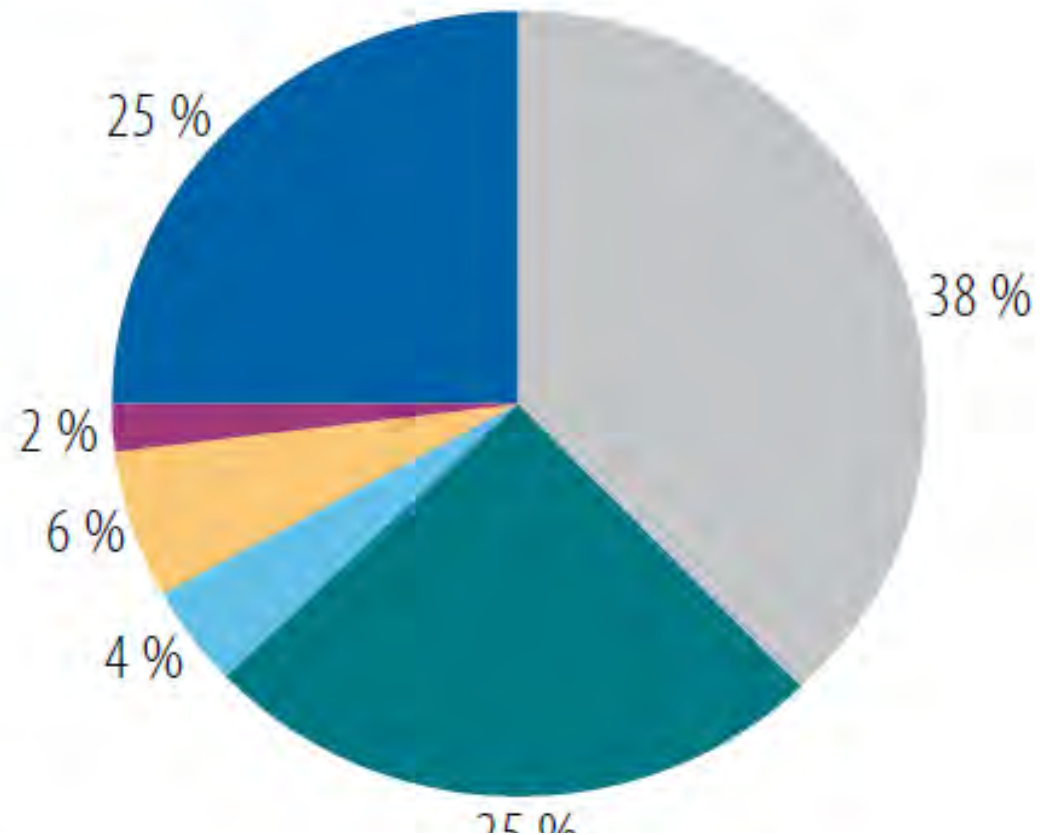
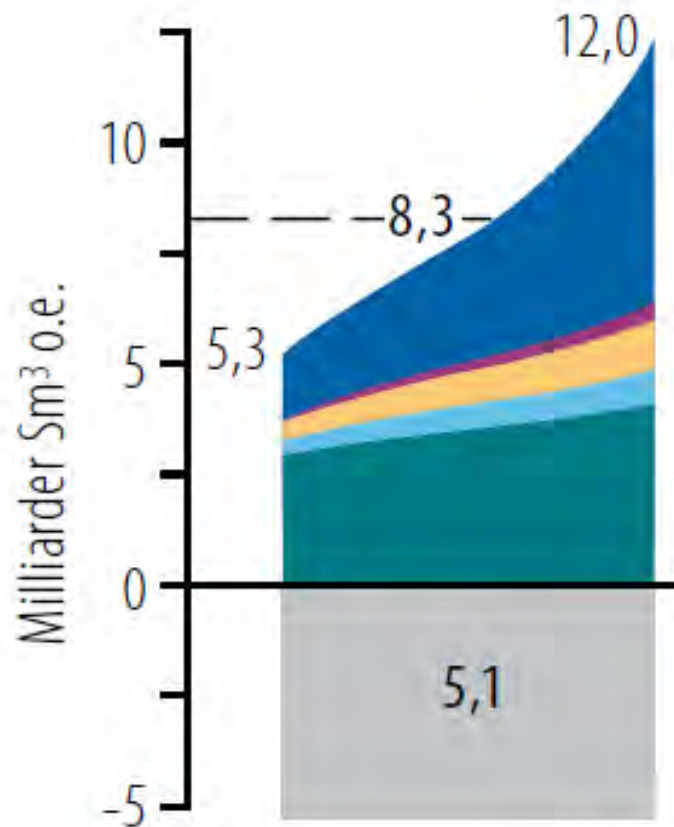


Figure 6.35 Maps of accumulated thickness of Ørret Formation sediments having very good (top), good (centre) and fair (bottom) hydrocarbon generation potential. Left: Pessimistic Setting, right: Optimistic Setting.

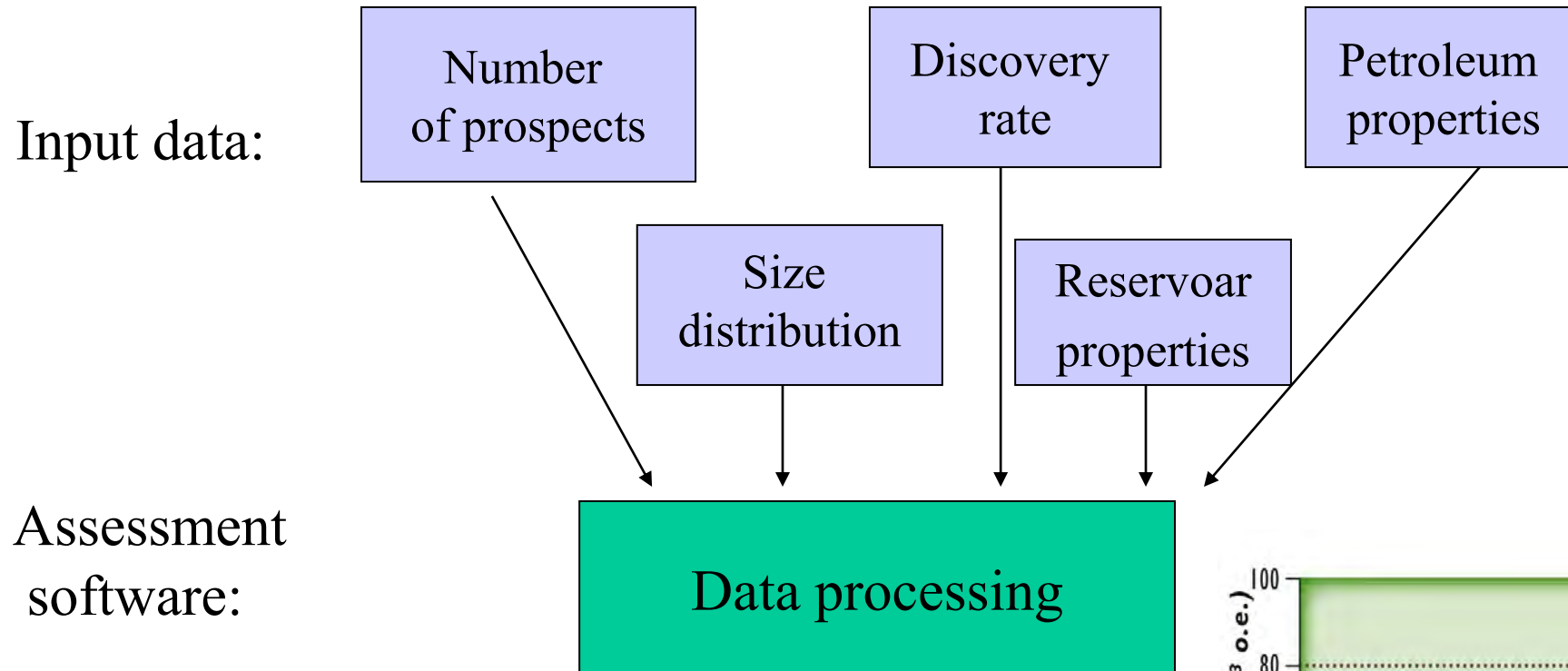


- Undiscovered resources
- Possible new technology for increased recovery
- Contingent resources, discoveries
- Contingent resources, producing fields
- Reserves
- Produced and sold

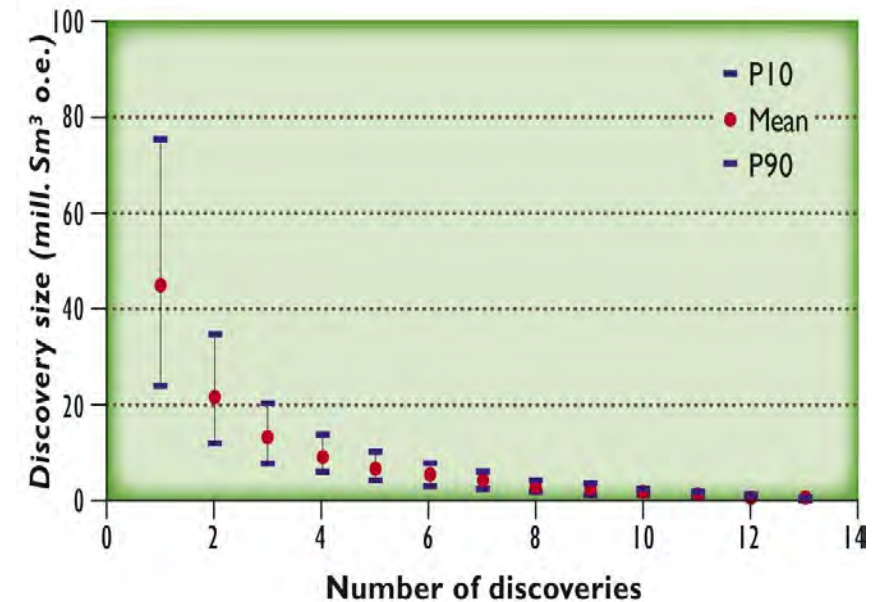
Distribution of total recoverable petroleum resources 31.12.2008

NPD Resource report 2009

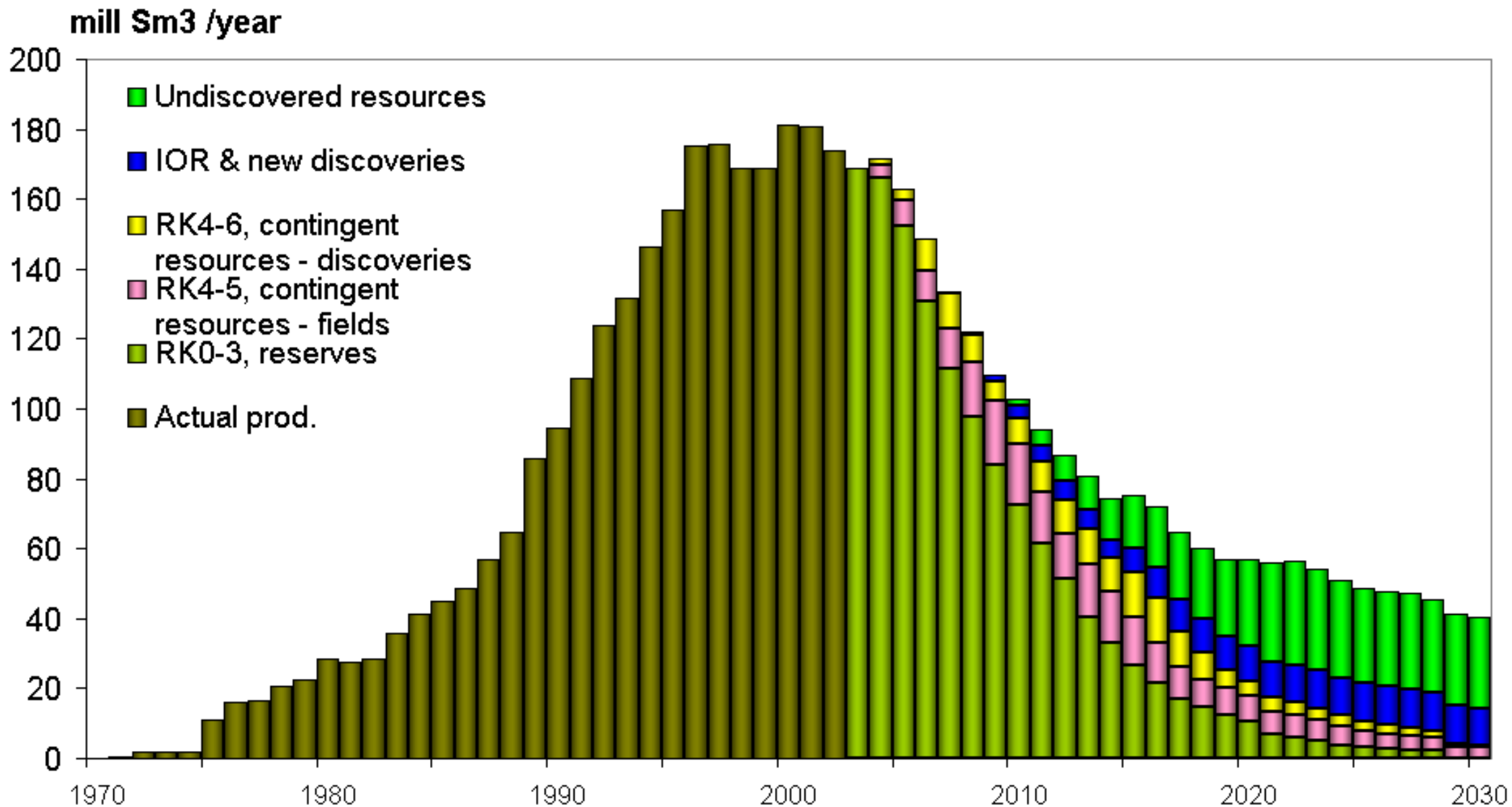
Statistical modeling

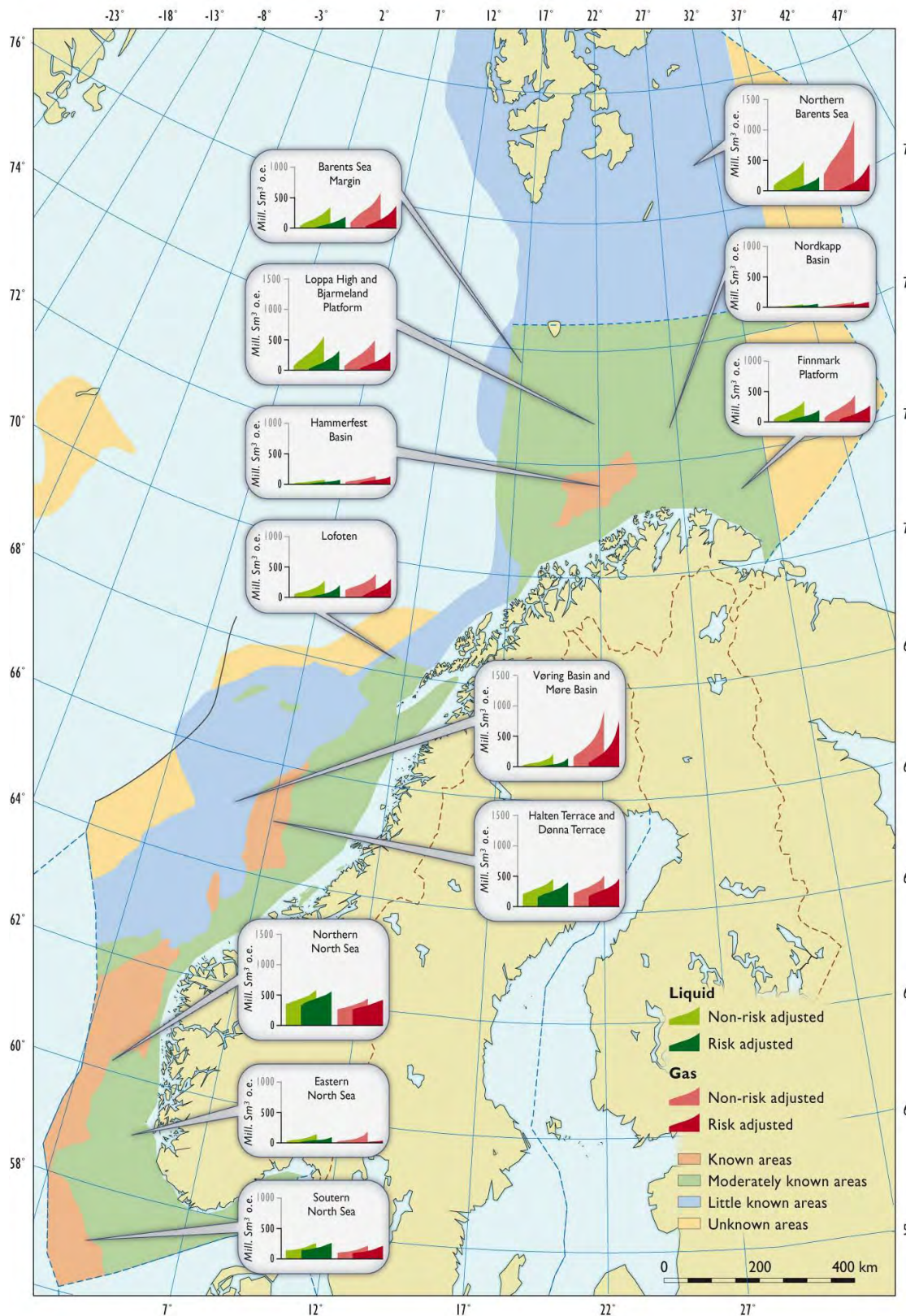


Results: Number and size distribution of future discoveries, volume of oil, gas and condensate.



Norwegian Oil Production, historic and forecast





Resource account for Norwegian shelf

Systematic analysis based on all data acquired

Published on paper and internet

Discoveries ranked by prognosed resource estimates, sorted on prognosed HC - phases

