

# The University Centre in Svalbard (UNIS)



Revised from Presentation at the force seminar 22<sup>nd</sup> May 2013 - focus on Arctic Basin studies

The University Centre in Svalbard (UNIS) is the world's northernmost institution for higher education and research, located in Longyearbyen, Spitsbergen at 78°N.

Arctic Biology

Arctic  
Geophysics

Arctic Geology

Arctic  
Technology

## Vision

The Department of Arctic geology seeks excellence in research and education of Arctic geosciences. By strengthening and integrating our expertise in palaeo- and modern climate change, cryospheric and geological processes, and hydrocarbon energy and basin studies, the department of Arctic geology aims at playing a leading role in geoscience research and education in the Arctic.

The University Centre in Svalbard  
Department of Arctic Geology  
May 2013

*Riko Noormets*  
*Riko.Noormets@unis.no*





# The University Centre in Svalbard Department of Arctic Geology May 2013



Alvar



Snorre



Hanne



Anne



Olafur



Doug



Maria



Riko

7 Adjunct professors  
5 Post Doc  
7 PhD Students  
+ 11 external PhD-s  
15-20 MSc Students  
+ c. 250 students

# Adjunct staff



Professor  
William Helland-Hansen  
University in Bergen  
**Seq. strat -basins**



Associate Professor  
Andy Hodson  
University of Sheffield  
**Glaciology**



Professor Ole Humlum  
University in Oslo  
**Physical Geography**



Associate Professor  
Jørn Hurum  
University in Oslo  
**Palaeontology**



Professor Martin Jakobsson  
Stockholm University  
**Marine geology and geophysics**



Professor Per T. Osmundsen,  
Geological Survey of Norway  
**Tectonics - basins**



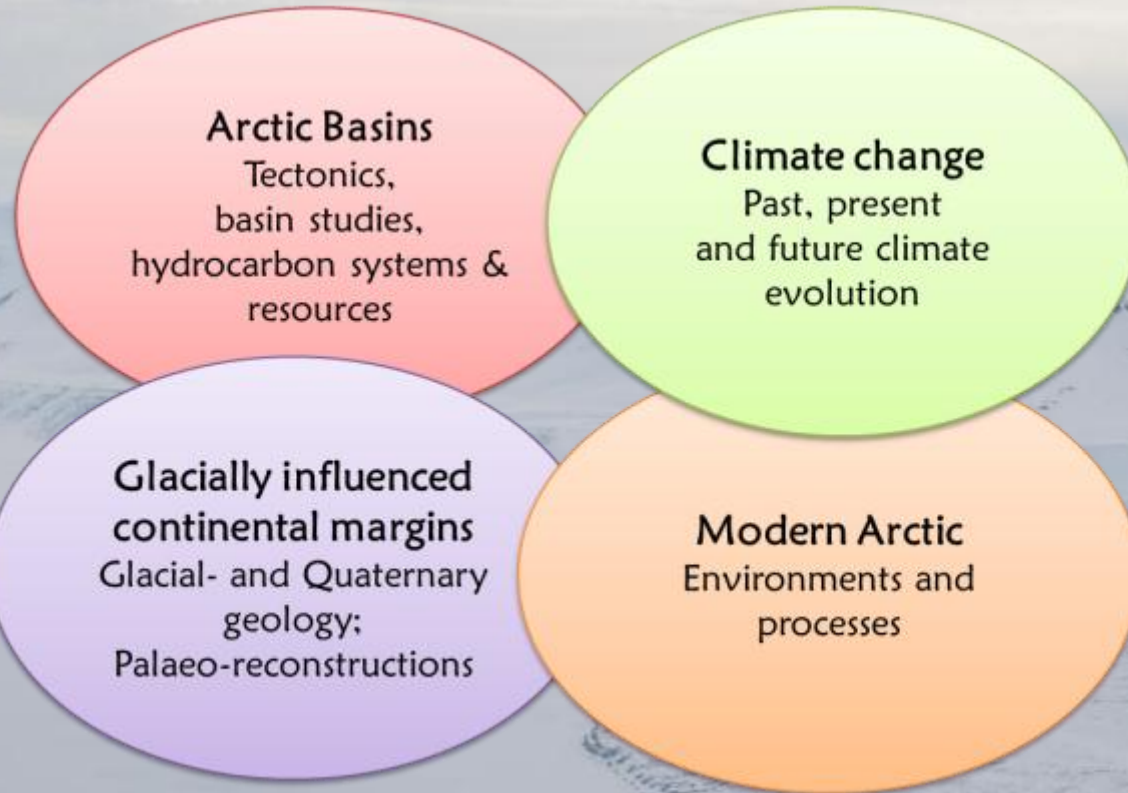
Professor Lars Stemmerik,  
University in Copenhagen  
**Carbonates - basins**



## Our vision:

To seek excellence in research and education of Arctic geosciences

### Research Themes



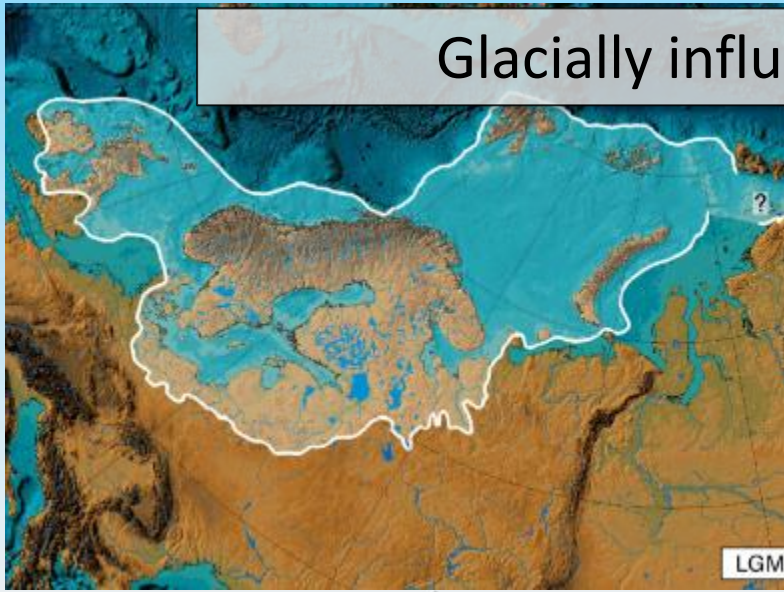
Funding agencies:  
Academic, Government,  
NFR, ERC, NCM,  
NPD, NGU  
Industry;  
Baker Hughes  
BP  
Centrica  
ConocoPhillips  
Det Norske  
Dong  
Eni Norge  
E.ON  
LNS  
Lundin  
OMV  
PGNiG  
RWE  
Statkraft  
Statoil  
Store Norske  
Talisman  
Total  
Tullow

National,  
International  
Networks and  
Programs

SUCCESS  
CLIMIT  
SVALI  
DEFROST  
NSINK  
ICEBOUND  
SVALASKA  
Page21  
CoP NARP  
GLANAM  
APEX  
PAST Gateways  
UiO, UiB, UiT, NTNU

*When we try to pick out anything by itself, we find it hitched to everything else in the universe*  
*John Muir*

# Glacially influenced continental margins



Marine ice sheets, ice shelves and tidewater glaciers

Svalbard-Barents Sea Ice Sheet evolution

Geomorphology and stratigraphy of Quaternary deposits in Svalbard

Linking the terrestrial and marine geological records

Effect of ice sheets on glacioisostatic movements





# Modern Arctic

Surging glaciers of Svalbard

Calving glacier models

Sea ice and its role in Arctic sediment transport

Arctic coastal system evolution

Periglacial geomorphology and landform dynamics

Thermal state of permafrost and its processes

Arctic snow and slope processes

Seafloor gas/fluid seeps and their environmental implications



*Photo Markus Eckerstorfer*



*Photo by: Håvard Juliussen*



*Photo Riko Noormets*



# Climate change

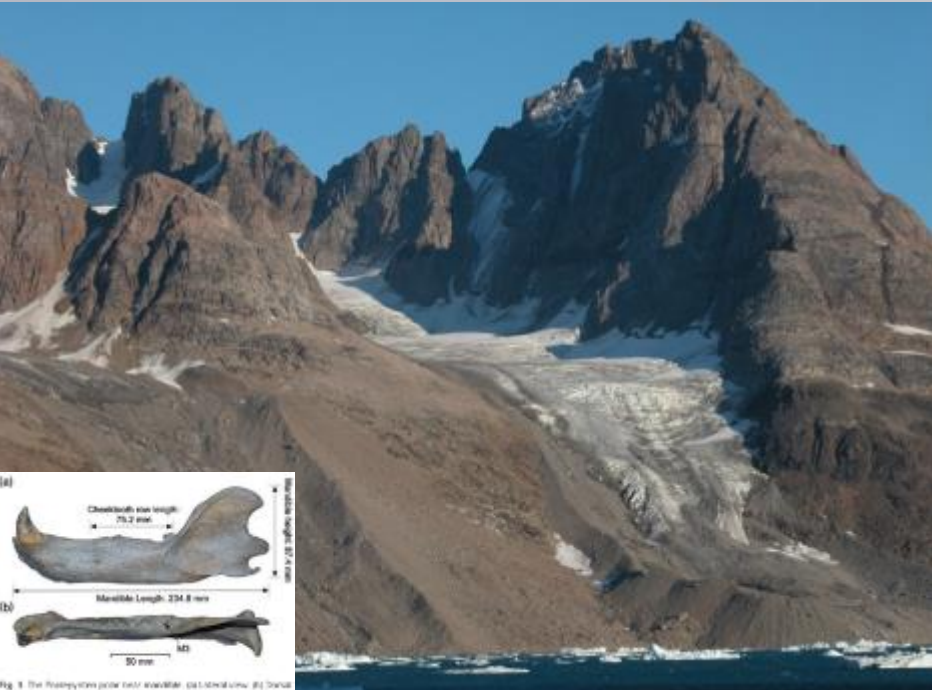


Photo Heidi Sevestre

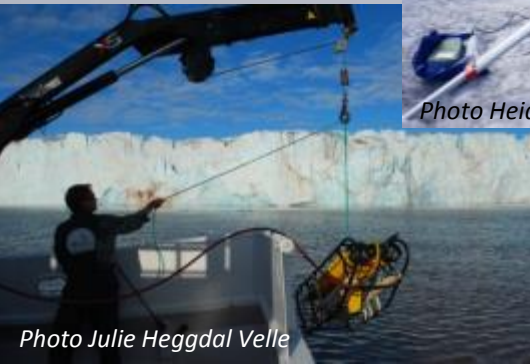


Photo Julie Heggdal Velle

Precambrian «Snowball» Earth

Glacial-interglacial cycles

Holocene environmental and climate change on Svalbard

Aeolian deposits in marine record as a Holocene climate proxy

Linking the terrestrial and marine geological records

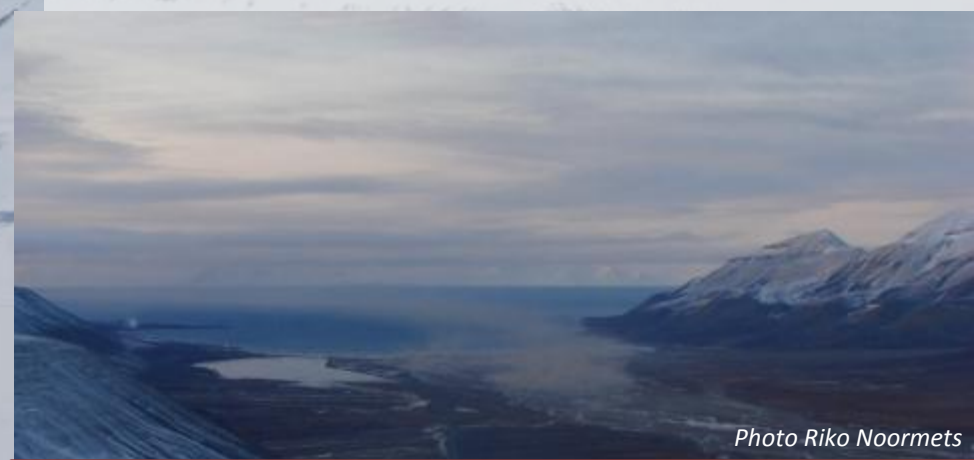


Photo Riko Noormets

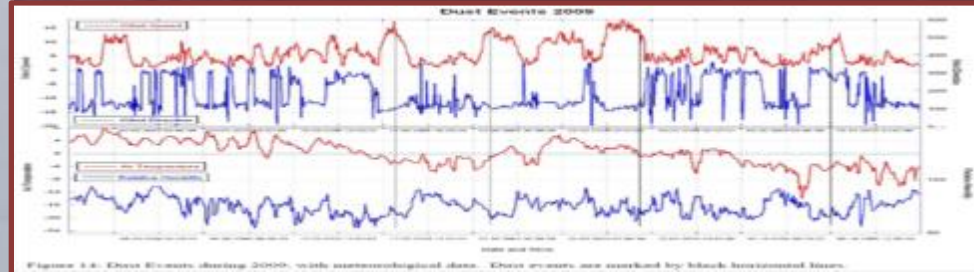


Figure 3.4: ECHO Climate (last 2000 years meteorological data). ECHO outputs are provided by: Norsk Environmental Data.





## SVALI & DEFROST

Nordic Centres of Excellence (NCoE)  
established 2010 for five years under the Nordic Top-level Research Initiative (TRI)

A major Nordic collaborative venture for studies of climate, energy and the environment aiming to improve our understanding of stability, variations and dynamics of the Cryosphere.

TRI largest sub-programme:  
***"Interaction between climate change and the cryosphere"***

- How fast is land ice volume in the Arctic and North-Atlantic area changing, and why?
- Will these processes continue to accelerate?
- What are the consequences for sea-level and ocean circulation
- What are the implications for society?



## **ConocoPhillips-Lundin Northern Areas Research Program 2013-2016**

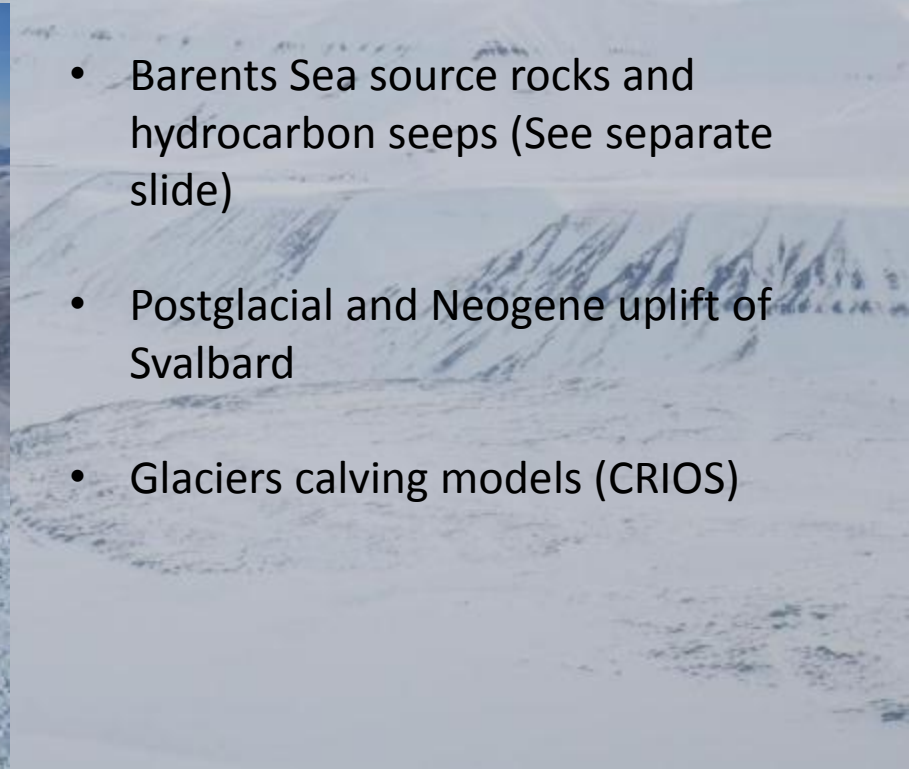
4-year research program

11 projects on Arctic environmental, operational, biological and hydrocarbon potential issues

Budget c. 100 MNOK

*Department of geology leads 3 projects with total budget of over 23 MNOK:*

- Barents Sea source rocks and hydrocarbon seeps (See separate slide)
- Postglacial and Neogene uplift of Svalbard
- Glaciers calving models (CRIOS)





## UNIS CO2 Lab

### Goals:

- Use the favourable conditions in and around Longyearbyen to develop, test and demonstrate technologies for carbon capture and storage.
- Establish a research and monitoring program that follows the migration of CO<sub>2</sub> through the sub-surface geological structures over time.
- Turn Longyearbyen into a high profile show case demonstrating the CO<sub>2</sub> value chain.
- Build field based university courses on Master and PhD levels along the CO<sub>2</sub> value chain.

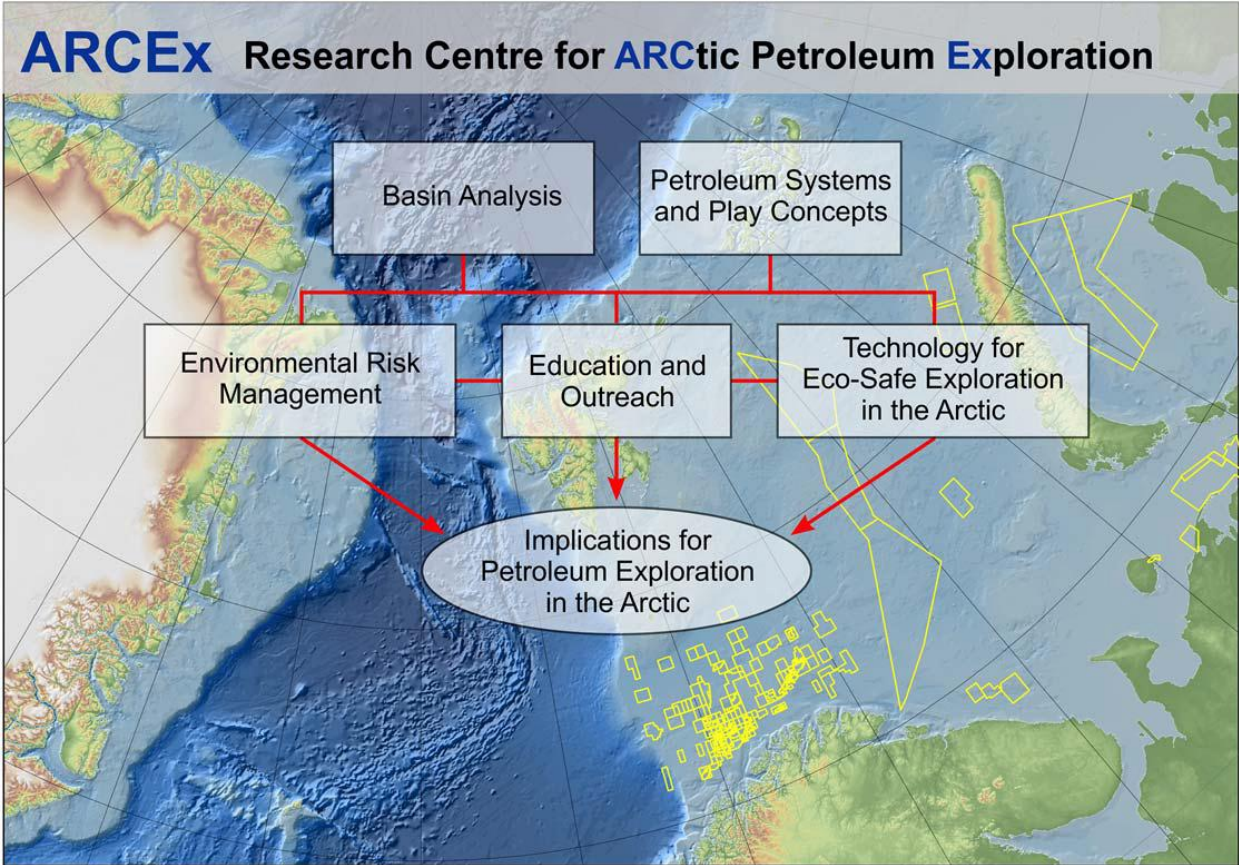


(See also separate slide)



## ARCEX

The Norwegian Ministry of Petroleum and Energy announced 31 May 2013 the establishment of the new Research Centre for Arctic Petroleum Exploration (ARCEX) led by University in Tromsø . ARCEX will acquire new knowledge about the petroleum resources in the Arctic and environmentally-friendly exploration techniques. UNIS as a partner of ARCEX and in cooperation with national and international universities will focus on Petroleum systems and play concepts





# Instruments



Photo Heidi Sevestre

**Instruments:**  
Ground-penetrating Radar (Georadar)  
Total station and high-accuracy DGPS  
Drill rig (also in hold off diamond core drilling to 700m)  
Multibeam echosounder  
Acoustic subbottom and side-scan profiler  
Gravity corer and ROV (*on loan through collaboration*)  
Seismic work station Laboratory  
Lidar (in cooperation with Arctic technology department and SNSK)

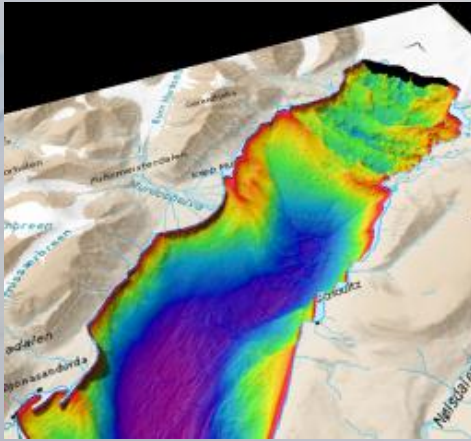
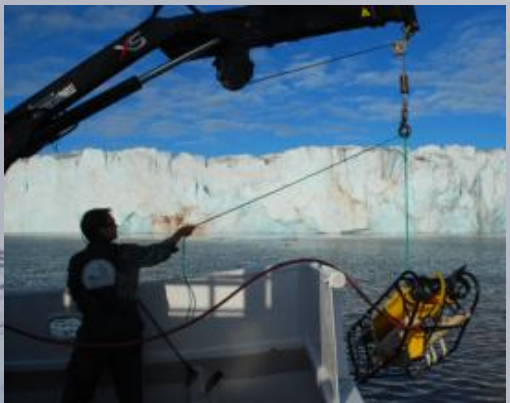
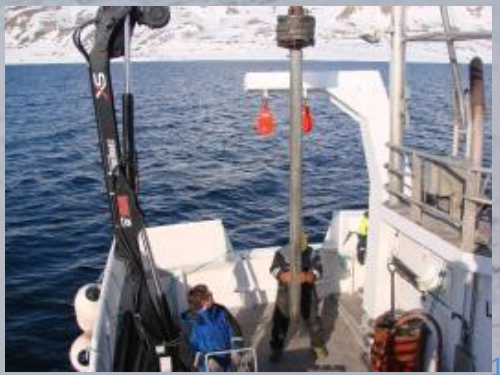


Photo by: Håvard Juliussen

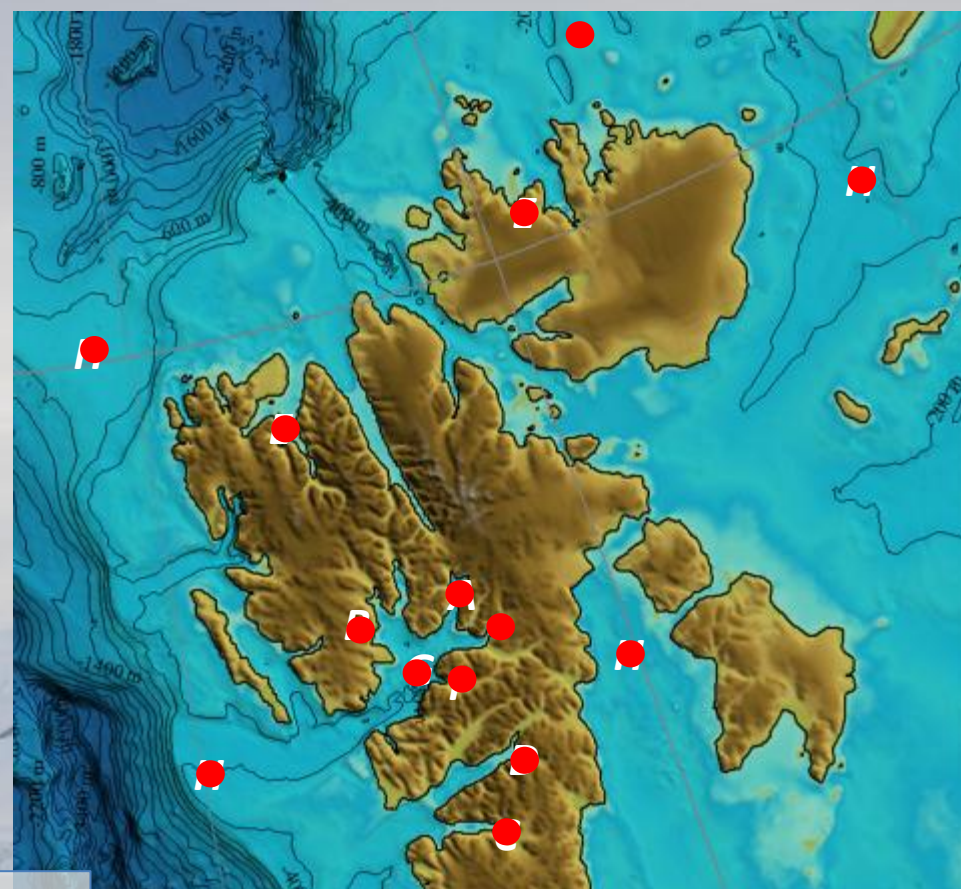


Video image of seabed in Adventfjorden





# Svalbard Geo Field Labs



- A. *Billefjorden rift basin lab*
- B. *Mediumfjellet fold-thrust belt lab*
- C. *Storvola sedimentary architecture lab*
- D. *Paulabreen glacier surge lab*
- E. *NW Spitsbergen and Atomfjellet icebound lab*
- F. *Nordenskjöld Land Permafrost Observatory*
- G. *Longyearbyen CO2 storage lab*
- H. *Svalbard marine and coastal landforms lab*





# Basin Studies in the Arctic Geology Department at UNIS



## Overview of subsurface R&D and petroleum geoscience

Geochemistry      Sedimentology/Sequence stratigraphy      Basin/Tectonics

Hydrocarbon seeps and geochemical characterisation and facies of potential source rocks

Facies development and sequence/seismic stratigraphy of the Triassic to Middle Jurassic

The link between basin tectonics, facies and porous-permeable carbonate facies development

Foreland Basin studies/structural geology

CO2 sequestration in Mesozoic strata of a Foreland Basin

Lower Cretaceous clastic wedges in the north Atlantic, Barents Sea and Svalbard

Carboniferous and Triassic extension and basin fill

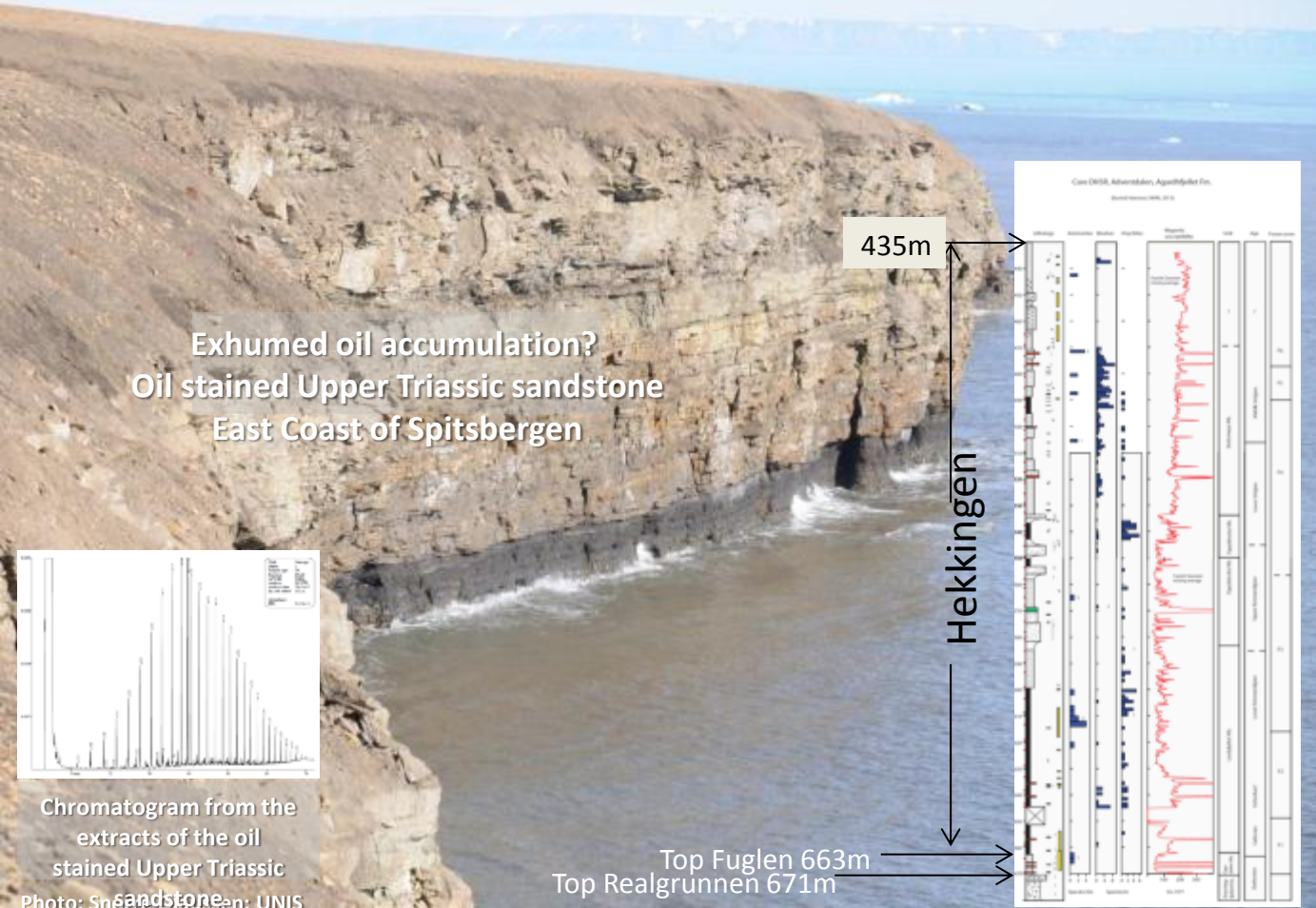
Fractured reservoirs

One under-graduate and nine graduate courses

*Basin studies at UNIS*  
2 Profs, 3 Assoc. Profs, 3 Postdocs, 7 PhD's, 7 Adjunct Profs (one position in earth geophysics).  
Hub of more than 20 external lecturers/geo-scientists  
Large network of collaborating research partners  
Extensive government and private funding

# Hydrocarbon seeps and geochemical characterisation and facies of potential source rocks

Southern Barents Sea source rocks exposed on Svalbard -Linking seabed hydrocarbon seeps to source rocks, hydrates, permafrost-Effect of glacial ice sheets to the source rock maturation, reservoir stability and fluid migration. *Hydrocarbon seeps and geochemical characterisation of potential source rocks in the Northern Barents Sea* which is part of the Lundin and ConocoPhillips Arctic Research Program 2012-2016 aims at characterizing the seabed hydrocarbon seeps and potential source rocks in onshore near shore Svalbard and northern Barents sea. The project will among others shed light on the distribution, composition, origin and timing of hydrocarbon seeps and oil stained strata, and their links to potential source rocks.



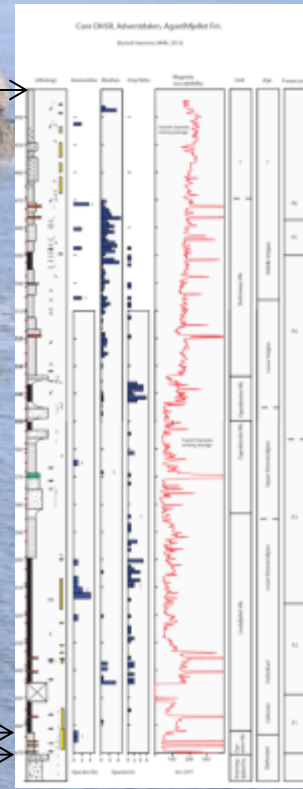
Exhumed oil accumulation?  
Oil stained Upper Triassic sandstone  
East Coast of Spitsbergen

435m

Hekkingen

Top Fuglen 663m

Top Realgrunnen 671m



## Project leader:

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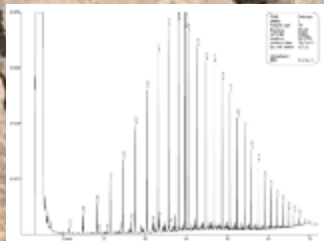
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Chromatogram from the  
extracts of the oil  
stained Upper Triassic  
sandstone



ConocoPhillips

Lundin



# Facies development and sequence/seismic stratigraphy of the Upper Triassic to Middle Jurassic

The project is called Fasena; *Facies distribution and sequence stratigraphy of the Late Triassic to Middle Jurassic of the Norwegian Arctic*. The study is tripartite and will focus on 1); the relationship between basin tectonics and sedimentation in the Late Triassic to Middle Jurassic , 2); the link between onshore (Wilhelmøya Sub Group) and offshore deposits (Realgrunnen Sub Group) in the Barents Shelf as well as 3); the correlation with contemporaneous deposits in the northern part of the Norwegian Sea and East Greenland



## Project leader:

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Oher

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The photo show approximate 10m x 30 m bedding surface of a Upper Triassic tidal sand flat with mega dunes (3D) and run off ripples.

Photo: Snorre Olaussen; UNIS



norge

# Facies development and sequence/seismic stratigraphy of the Triassic

This project will aim to improve the prediction of sandstone prone facies of the clinoforms in the Snadd Formation, Barents Sea. Further the project will establish a detailed facies model and depositional architecture of tidal and fluvial deposited sandstones from the Snadd Formation and the onshore counterpart on Svalbard



The photo shows approximately 7m thick tidal bar of the De Geerdalen Formation

## Project leader

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# The link between basin tectonics, facies and porous-permeable carbonate facies development

This project *Upper Paleozoic enhanced porosity and permeability by karstification in the North Sea - and Barents Sea Basins* will develop sedimentological and diagenetic models for carbonate platform successions associated with major salt basins based on comparative studies of the Zechstein carbonates in NW Europe and the Gipsdalen Group carbonates in the greater Barents Shelf area and Svalbard.



Karst development in the Billefjorden rift

Photo: Lars Stemmerik; UNIS/UiCopenhagen

## Project leader:

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## Lower Cretaceous clastic wedges in the North Atlantic and Svalbard - LoCra

The project will aim to improve the basin configuration and fill of the Lower Cretaceous basins in the high Arctic. The study aims on understanding the basin evolution, stratigraphy, structural styles and paleogeographic setting of clastic wedges in the Greater Barents Sea area including Svalbard, Franz Josef Land, the northern Norwegian Sea, and on- and offshore East Greenland, and they relation to the North American arctic basins



### Project leaders:

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and

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In cooperation with scientists from University in Oslo, Bergen, Copenhagen, Moscow, Austin, Omaha, and NPD, CSG and GEUS  
Sponsored by 14 oil companies

For details see home page  
WEB site;

<http://locra.ux.uis.no/>



## Carboniferous and Triassic extension and basin fill

The project aim to improve the reconstruction of the Triassic northern Barents Shelf; by integrating geological studies onshore Svalbard with offshore seismic data, analysis and numerical and analogue modeling. The project will first focus on tectonics, basin development and sedimentary infill of the gentle sags and faults of the Triassic of the northern Barents Shelf and later on nearby Arctic linked basins as Northern Greenland and Sverdrup Basin-



Kvalpynten upper Triassic growth fault system, South Edgeøya;  
interacting shallow and deep rooted fault system

### Project leader:

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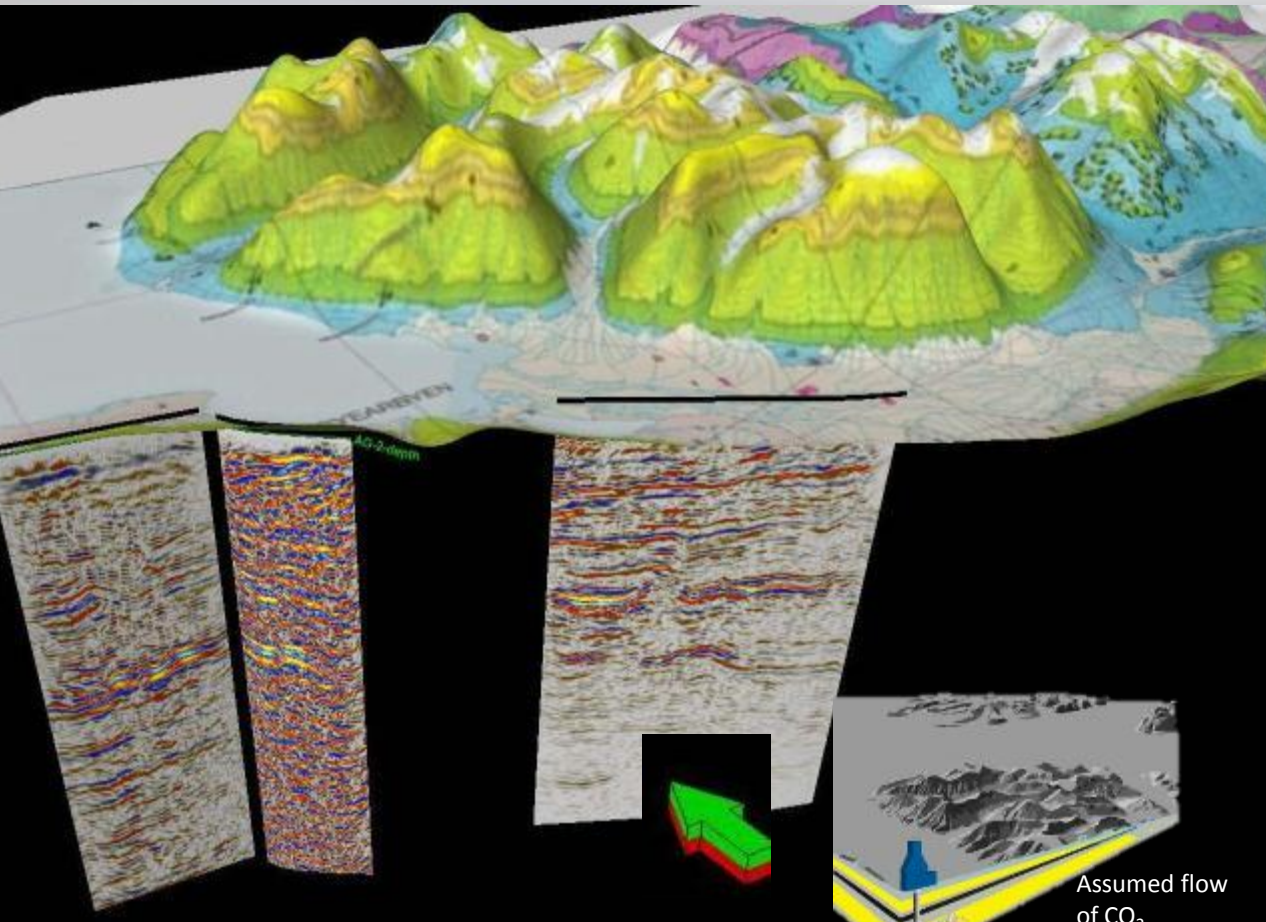
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## CO2 sequestration in Mesozoic strata of a Foreland Basin

A motivation for the Longyearbyen CO2 project is the global need for CO2 injection test sites. We need to know more about re-servoir qualities, CO2 storability and risks of subsurface leakage. Research communities and industries need field data to simulate liquid flow and develop reservoir models.

For detail see web page: <http://co2-ccs.unis.no/>



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A NFR (Climit/industrial R&D project



# Foreland Basin studies/structure geology

This activity targets three R&D areas:

- 1) Geometry and kinematics of the Spitsbergen fold-thrust belt, with fractured reservoir characterization
- 2) Sedimentary infill characteristics of the foreland basin system
- 3) Link between fold-thrust belt and basin response

Project leaders:

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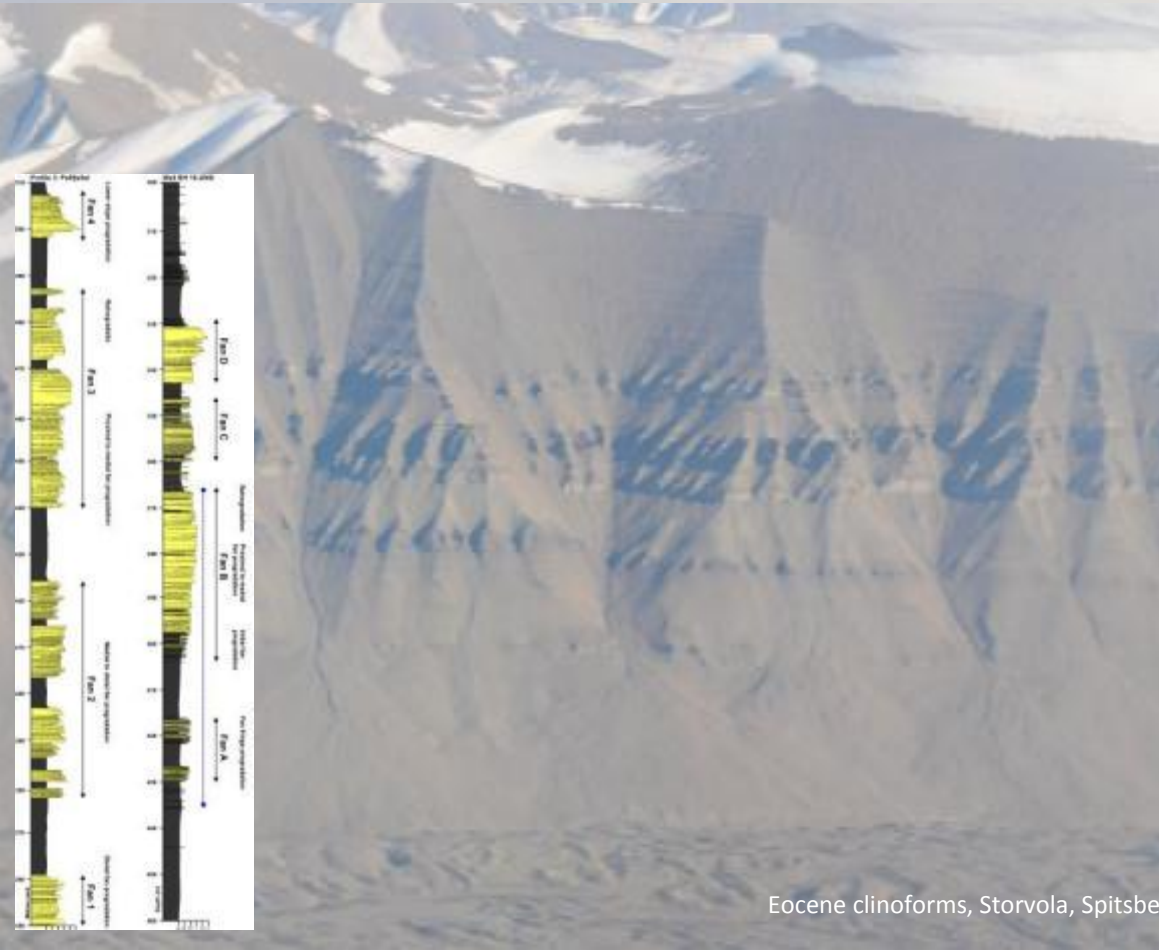
Other

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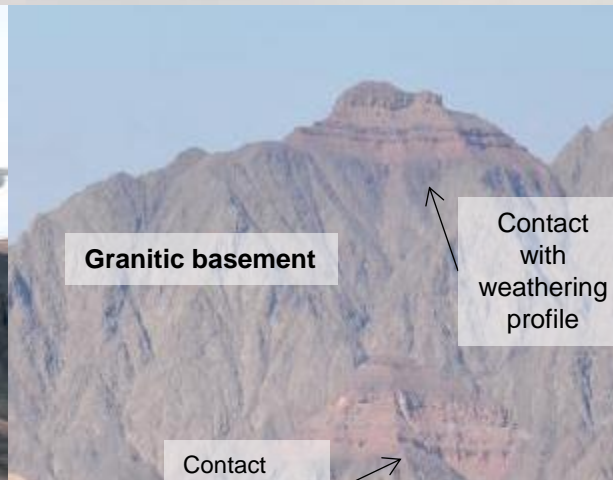
Eocene clinoforms, Storvola, Spitsbergen



# Fractured basement reservoirs

The project Compare basement deformation and weathering between Svalbard and Sinai (Egypt), as analogue to basement oil-discoveries/fields. The project will through description of near-top basement fracturing and weathering qualify and quantify key parameters for this type of reservoirs and assess their impact on fluid flow with implications for production strategies.

Study areas are Sinai, Egypt and Billefjorden, Svalbard



## Project leader:

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Gouda Abdel-Gawad (Beni-Suef U., Egypt)

Mohamed Abd el Fattah (Beni-Suef U., Egypt)



# Graduate courses in Sedimentary Basin and Petroleum Geosciences

*AG313/813 – Fossils and Evolution of Life*  
5 ECT

*AG336/836 – Rift Basin Reservoirs*  
10 ECT

*AG332/832 – Fold-thrust belts*  
10 ECT

*AG338/838 – Sedimentary facies*  
10 ECT

*AG323/823 – Sequence Stratigraphy*  
10 ECT

*AG341/841 – CO<sub>2</sub> sequestration*  
10 ECT

*AG334/834 – Polar Petroleum Provinces*  
10 ECT

*AG343/843 – Carbonate Sedimentology*  
5 ECTS

*AG335/835 – Polar Seismic Exploration*  
10 ECT

## Undergraduate course

*AG209 – The Tectonic and Sedimentary History of Svalbard*  
15 ECT