U N I V E R S I T Y O F B E R G E N

Department of Earth Science

The Faculty of Mathematics and Natural Sciences

Research and education at the Department of Earth Science, University of Bergen

Professor Atle Rotevatn

Deputy Head of Petroleum Geoscience

Department of Earth Sciences: facts & figures

Research Groups

- ✓ Quaternary Earth Systems
- ✓ Geodynamics
- ✓ Geobiology
- ✓ Petroleum Geoscience

Partners in

- ✓ COE Centre for Geobiology
- ✓ Bjerknes/SKD
- ✓ Bergen Deepmarine Center
- ✓ Center for Geothermal Energy
- ✓ SUCCESS
- ✓ ARCEX
- ✓ etc.

Staff:

- Academic staff: 37
- Adjunct positions: 9
- Technical staff: 25
- Administrativ staff: 10
- Postdoctors: 34
- Research fellows:52
- Active emeriti: 5

Students:

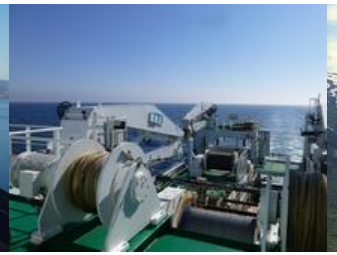
- Bachelor: 270
- Master: 114
- Ph.D: 57

Budget:

- Department budget 93 MNOK
- External funding: 107 mill. NOK
  - NFR 65 MNOK og EU 8,2 MNOK





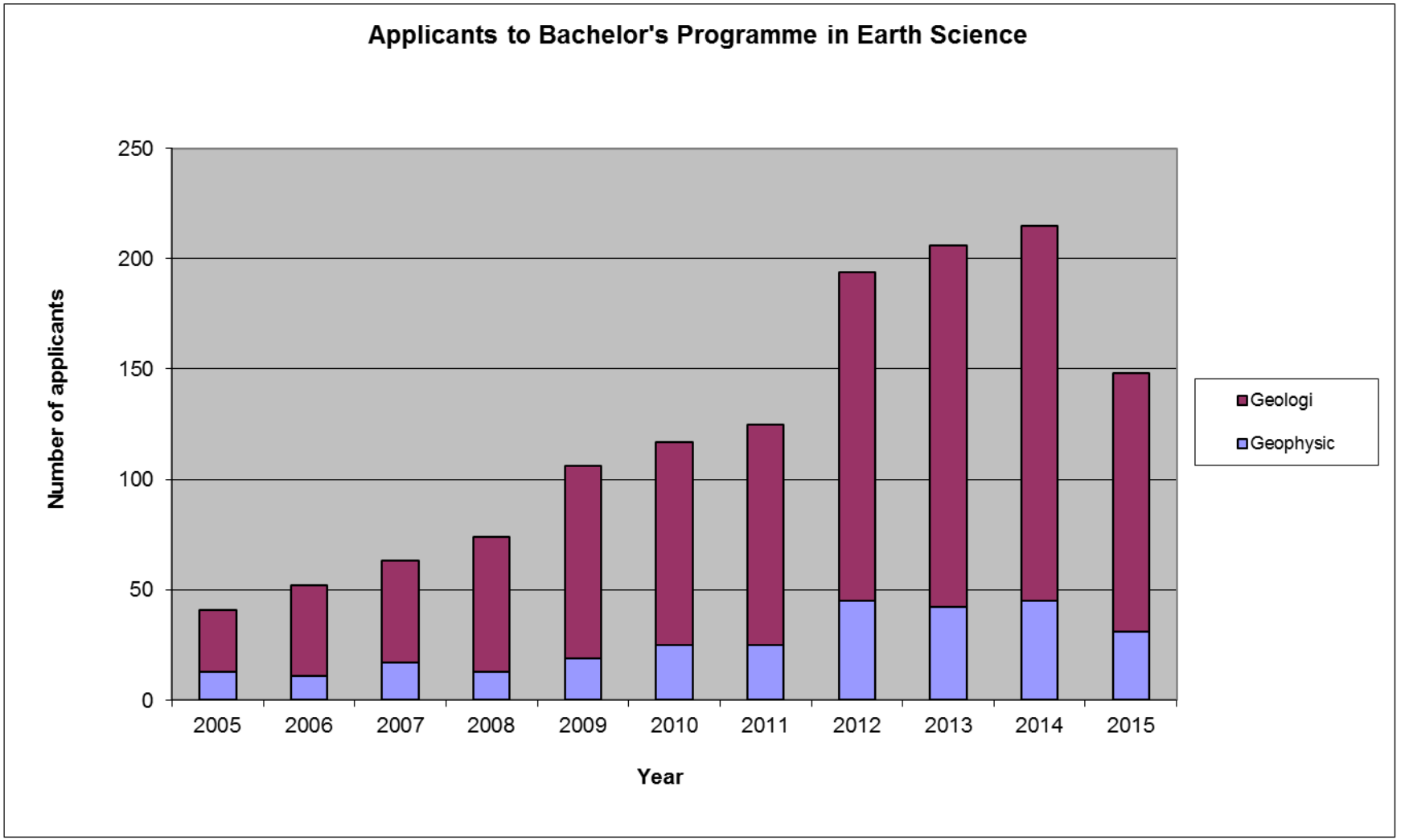



440 students currently follow a degree program at the department:

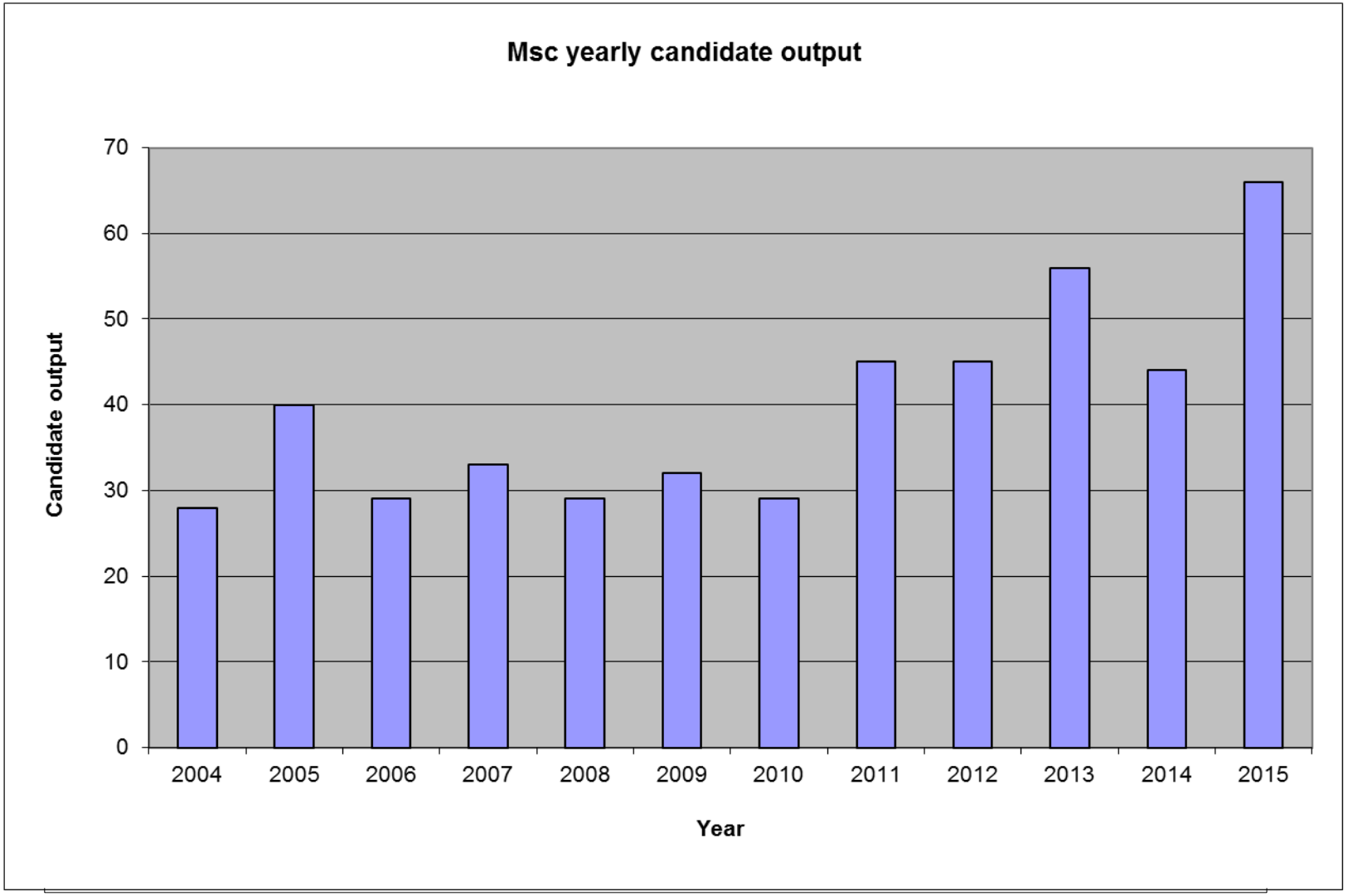
- 3 Year Bachelor programs in geoscience (~270 students)
  - Geoscience

- 2 Year Master programs (114 students)
  - Marine Geology and geophysics
  - Petroleum geoscience
  - Geodynamics
  - Quaternary geology and paleoclimate
  - Geobiology

- 3 Year PhD program: (57 candidates)
  - Individual projects; closely related to affiliated research centres and research groups



We aim at taking in 95 students per year


Msc yearly candidate output
Candidate output
70
60
50
40
30
20
10
0
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
Year

Infrastructure at the department of Earth Science

- Laboratory clusters
  - Mass spectrometry labs
  - Earth LAB
    - National infrastructure for sediment analyses
  - FARLAB
    - state-of-the-art national facility for light stable isotope analyses
  - 3D Seismic Labs
    - High-performance work stations for seismic interpetation, visualization, reservoir modelling and flow simulation
- Field equipment
    - Marine and terrestrial seismic aquisition
- Marine infrastructure
  - Including vessels, seimic equipment , ROV




KEY AREAS OF RESEARCH

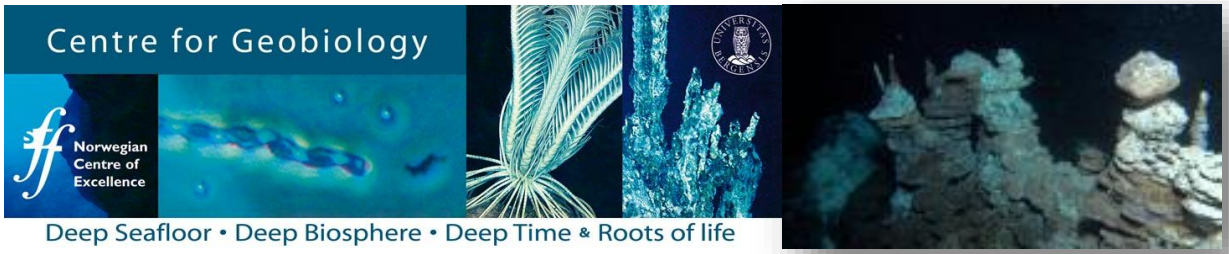
Key research areas - Quaternary Earth Systems

2 post docs
12 PhD candidates
34 Master students

- Glaciation history
- Marine geology
- Past climate changes
- Climate dynamics and forward modelling

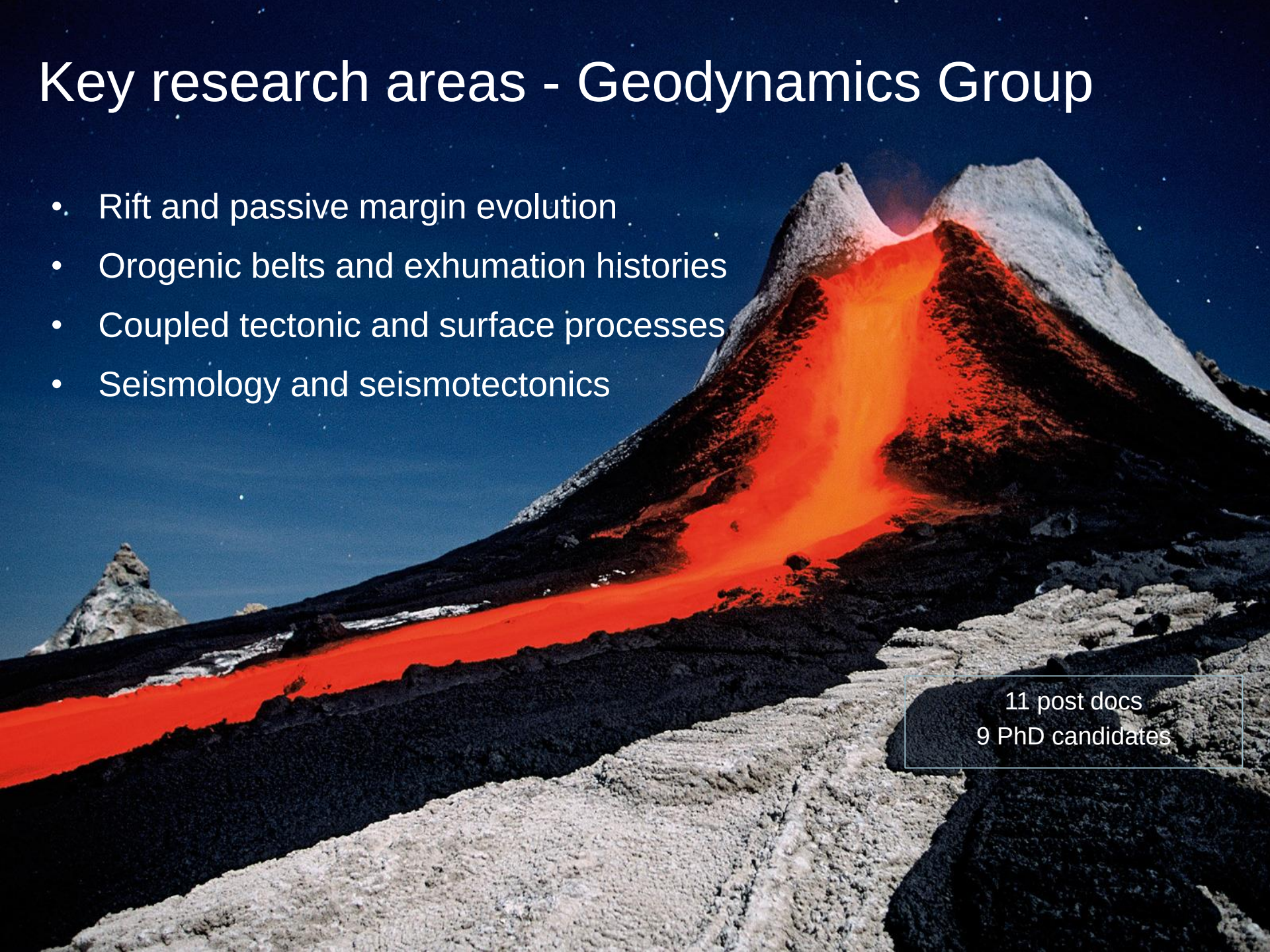
Key research areas - Geobiology

8 PhD candidates
10 Master students



- Geodynamics of the Deep Seafloor
- Deep Biosphere
- Life in Extreme Environments & Roots of Life
- Early Earth
- Earth System Evolution

Key research areas - Geodynamics Group



- Rift and passive margin evolution
- Orogenic belts and exhumation histories
- Coupled tectonic and surface processes
- Seismology and seismotectonics

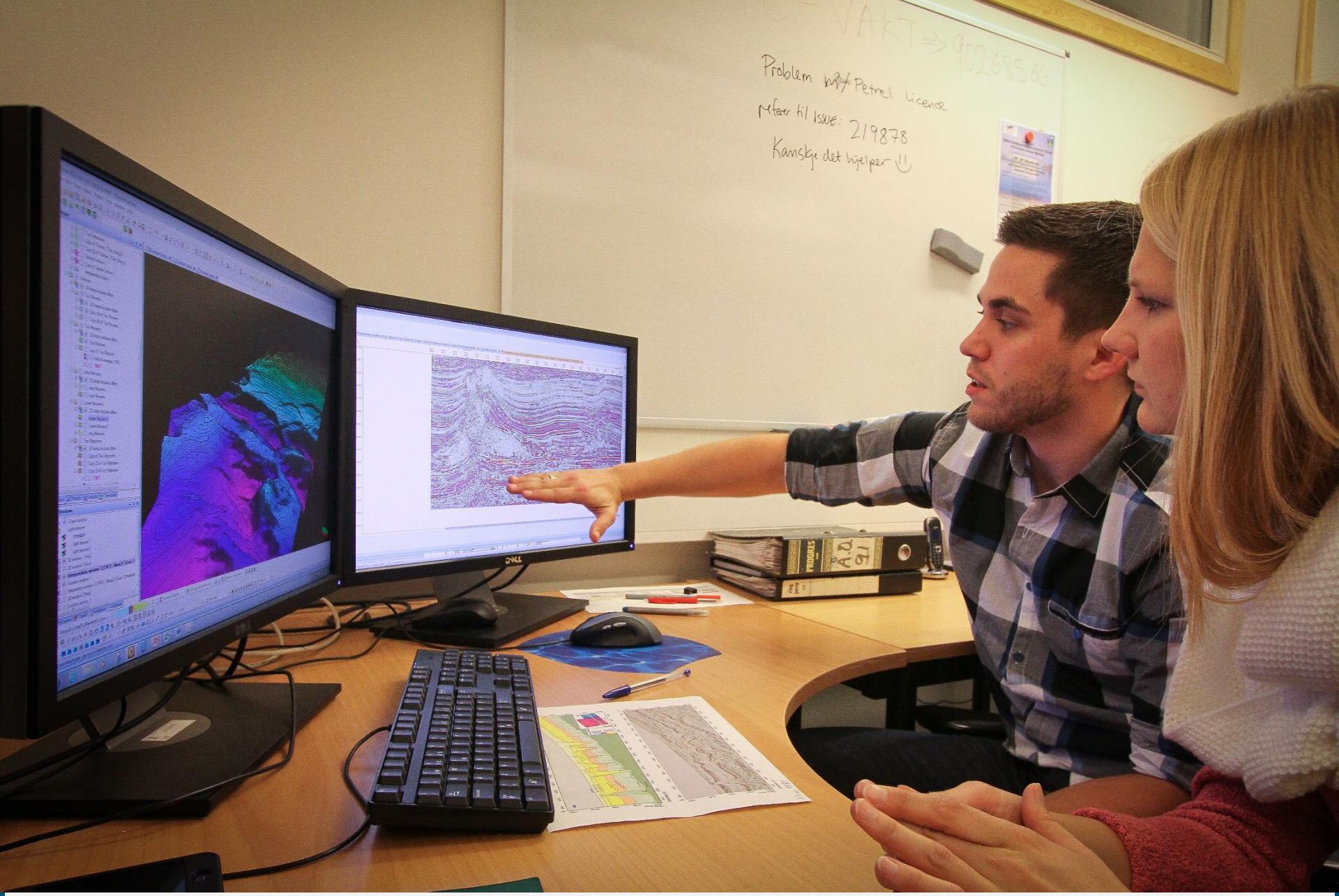
11 post docs
9 PhD candidates

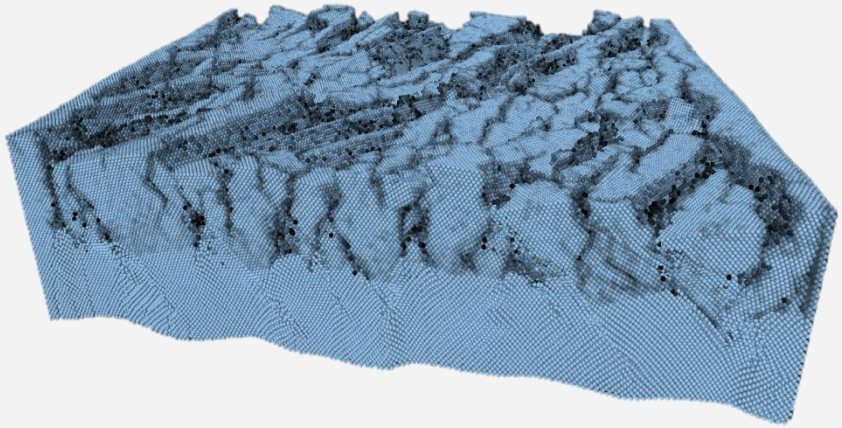
Key research areas - Petroleum Group

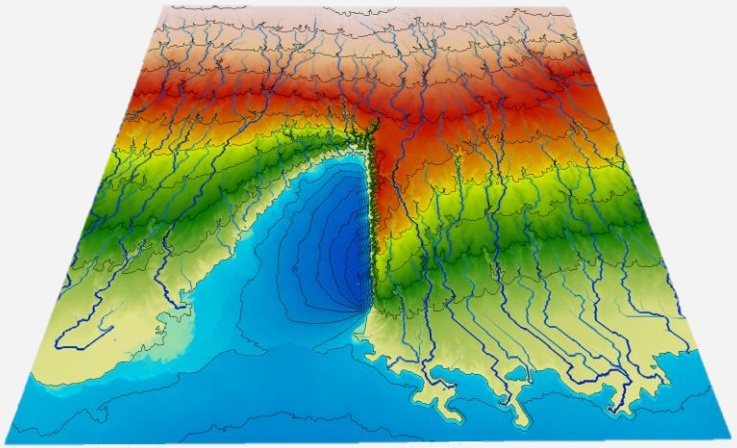
17 post docs
14 PhD candidates
55 Master students

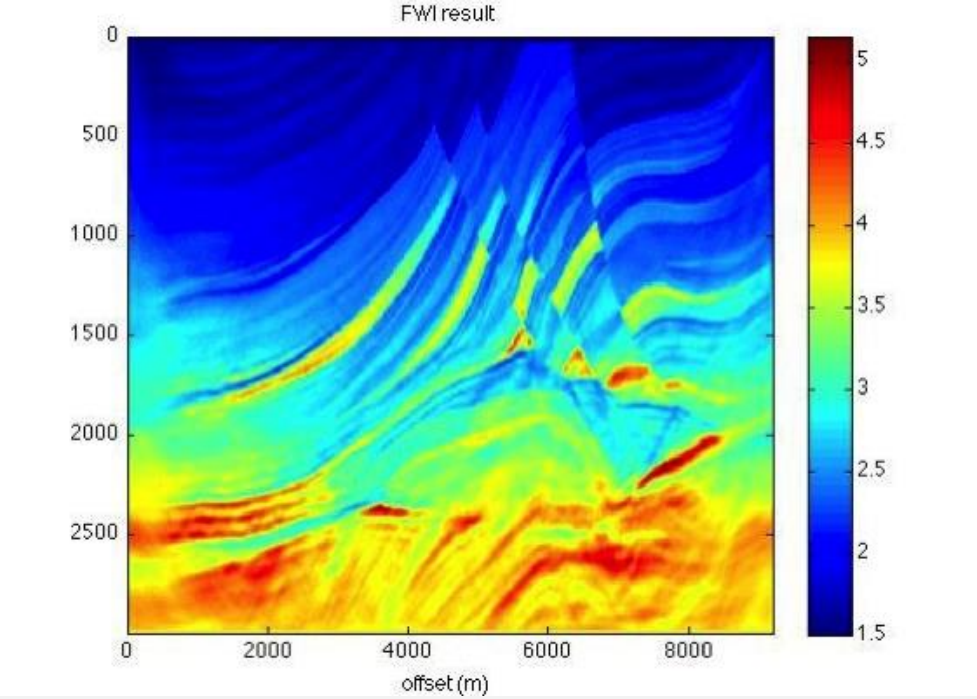
- Sedimentary and tectonic processes and architechture
- Seismic analysis: modelling, processing, inversion, rock physics and interpretation
- Subsurface mapping energy potentials (hydrocarbons and heat) and possible sequestration of greenhouse gases
- Fascilitation of large a scale arctic seismic laboratory

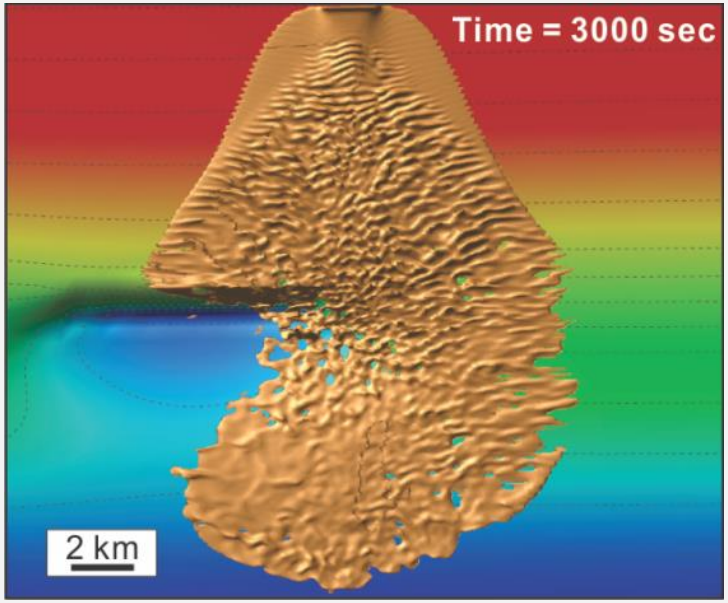

DELL
DELL
DELL


Problem
Petrel
Licence
219878






FWI result
0
500
1000
1500
2000
2500
0
2000
4000
6000
8000
offset (m)
5
4.5
4
3.5
3
2.5
2
1.5


Time = 3000 sec
2 km

Sedimentary processes and palaeoenvironments

Clastic sedimentology

Continental systems
Shallow marine systems
Deep marine systems

Carbonate sedimentology

Shallow marine tropical systems
Shallow marine temperate systems
Pelagic systems

Shoreface succession, Upper Cretaceous Ferron Sandstone, Utah

Great Barrier Reef, Queensland, Australia

Sequence stratigraphy and biostratigraphy

Sequence stratigraphy

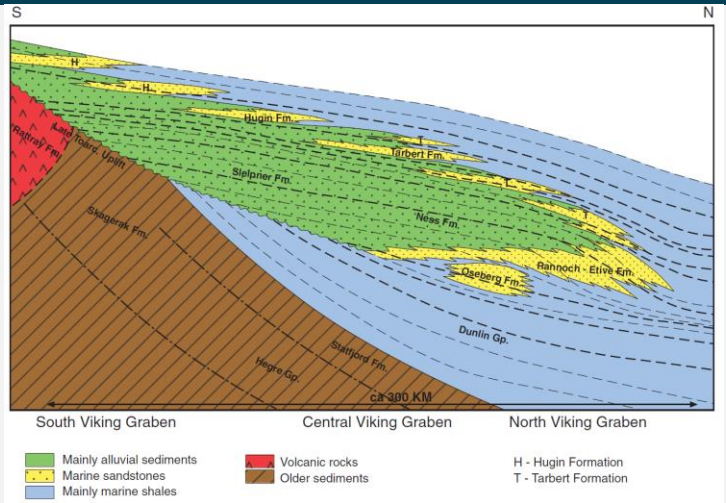
Sequence stratigraphic analysis of clastic systems

Shoreline trajectory analysis

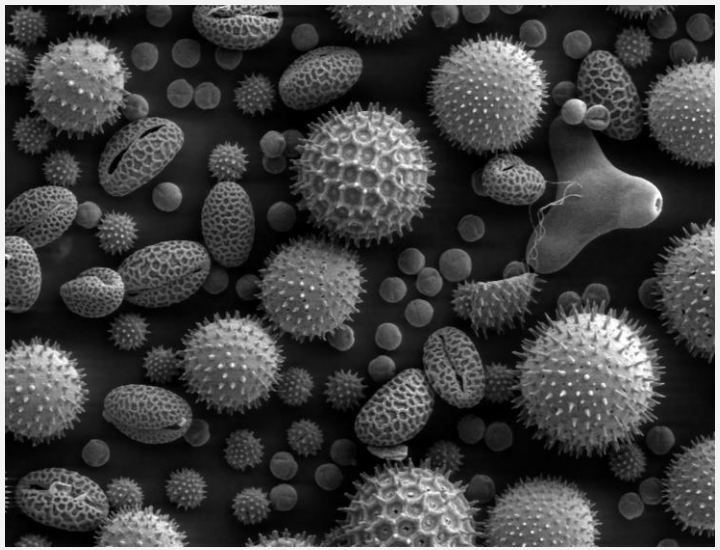
Biostratigraphy and palynology

Studying pollen grains/marine microfossils to reconstruct past environments & datings

Triassic & Paleozoic of the Barents Sea



Vikkng Graben sequence stratigraphic chart



Scanning electron microscope image of different types of pollen grains

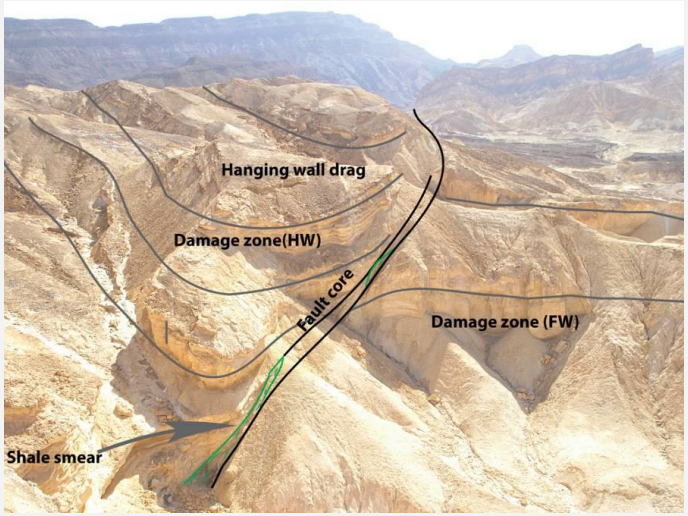
Structural geology and tectonics

Fault evolution

Models for fault evolution
Fault scaling behaviour
Segmentation and growth

Geometry/architecture, and flow properties of faults and fracture systems

Faults, fractures and deformation bands
Porous sandstones
Carbonate rocks
Basement rocks
Weathered basement rocks



Extensional fault affecting Eocene carbonate rocks, Sinai, Egypt

Fault damage zone of deformation bands, Molly's Castle, Utah

Structural and sedimentological reservoir heterogeneity

Reservoir modelling and flow simulations

Sedimentological heterogeneities

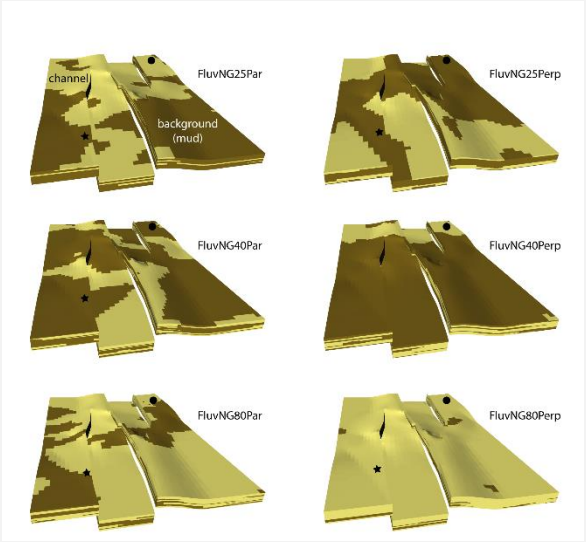
Clinoforms
Delta lobes

Faults

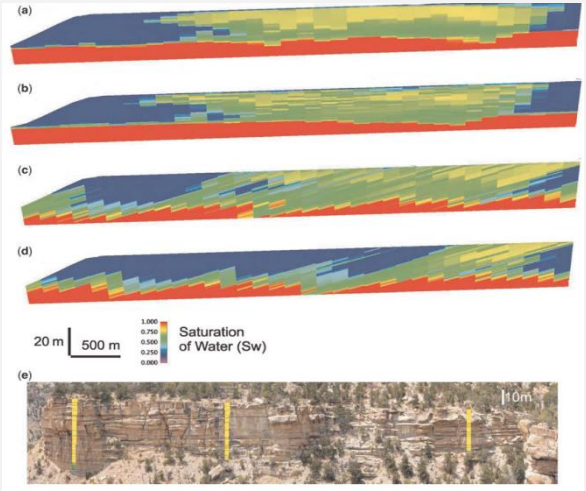
Fault-controlled fluid flow
Sub-seismic heterogeneities and effect on flow

Combined effects

Effects of faults in different reservoir types
Effects of sedimentological vs structural heterogeneities



From Rotevatn et al. (2009)

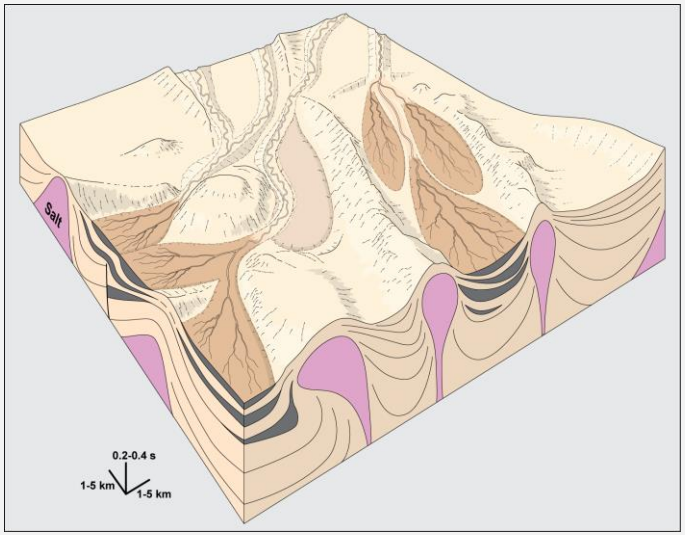


From Howell et al. (2008)

Tectono-sedimentary basin analysis

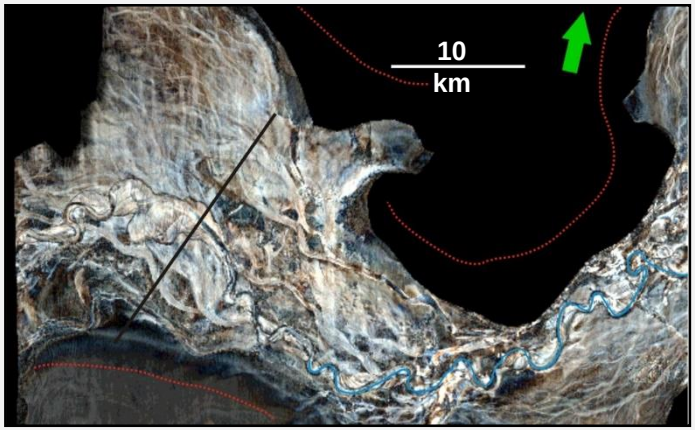
Earth systems focus on the coupling of:
Structural/tectonic evolution
Depositional systems evolution
Drainage evolution
Surface processes/landscape evolution

Outcrop, subsurface, numerical modelling Interaction of tectonic/structural and depositional systems



Conceptual model of slope channel systems across salt tectonic sea floor topography

Cretaceous syn-rift deposits, Wollaston Forland Basin, East Greenland

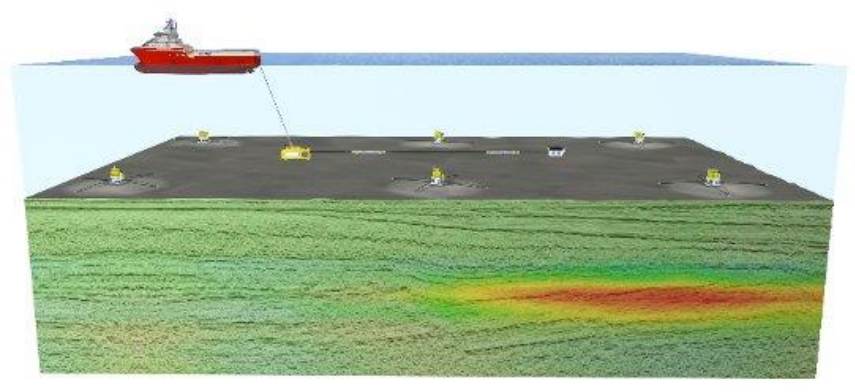


Slope channels systems; spectral decomposition + RGB blend

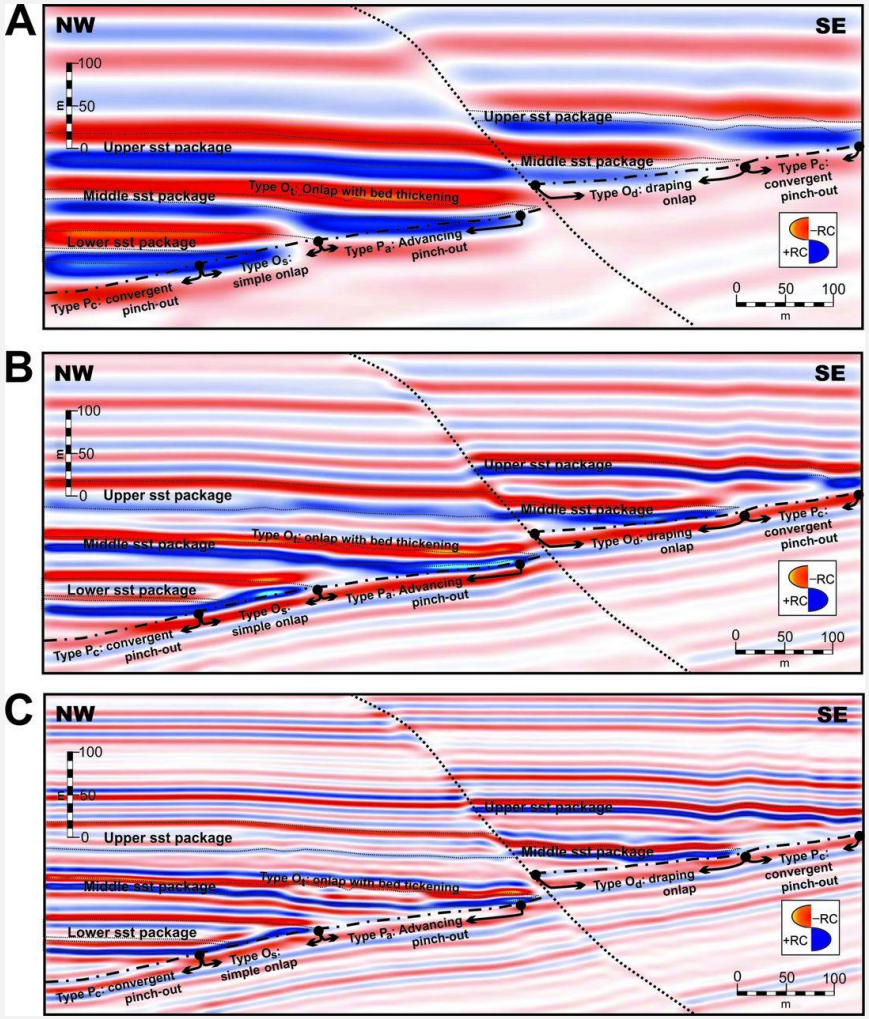
Reservoir geophysics

Reservoir/petroleum geophysics
Geophysical reservoir characterization
Seismic processing and imaging
Seismic modelling
Rock physics

Integration of data types
Quantitative integration of 4D seismic, electromagnetic and production data



Conceptual display of integrated EM and seismic data



Seismic modelling of depositional geometries (from Bakke et al. 2013)

Institutt for geovitenskap
Department of Earth Science

Seismic acquisition and processing

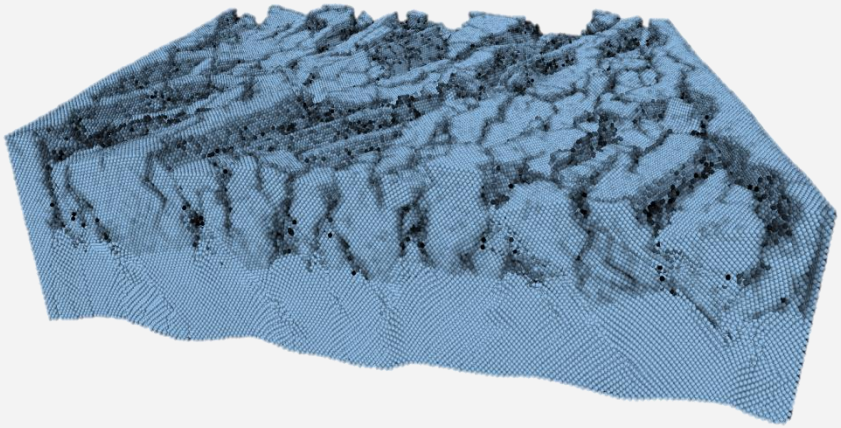
Seismic acquisition and processing
Marine 2D
OBS
Onshore

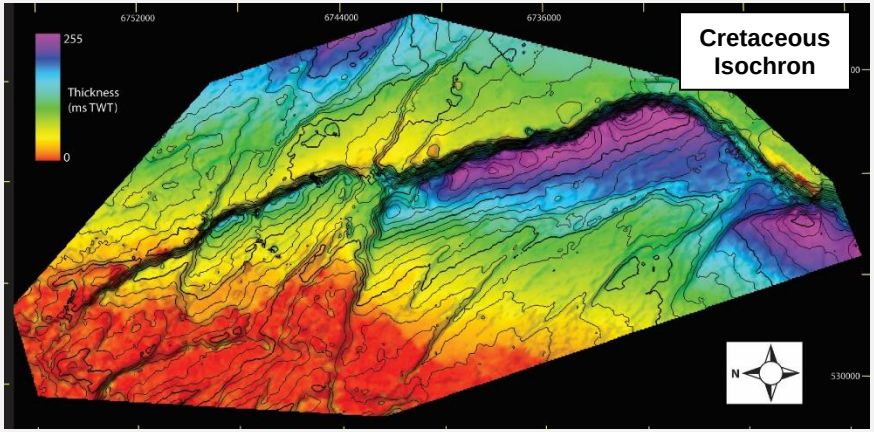
Particular focus on polar regions
Svalbard
Barents Sea

Seismic acquisition during SVALEX field course

Seismic acquisition in Svalbard

Example projects





Understanding the time represented by siliciclastic sedimentary deposits

PhD student: Tore Aadland

Project start date/duration: 2014-2017

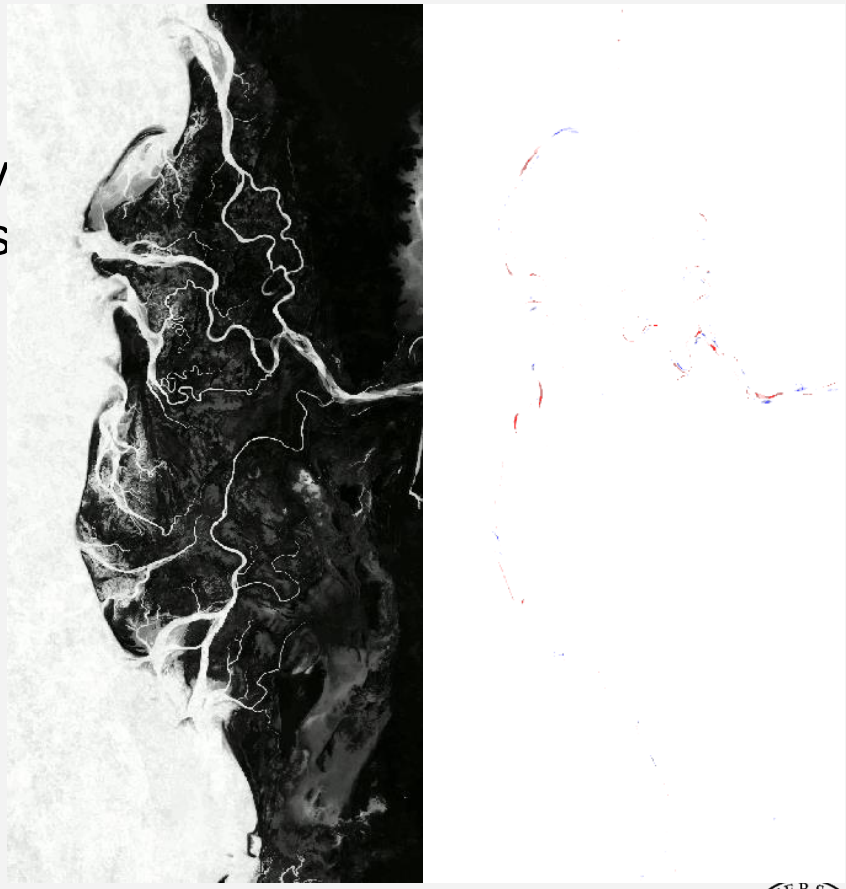
Supervisor: William Helland-Hansen

ARCEx
Research Centre for
Arctic Petroleum Exploration

Project Outline

Understanding how time is represented by sedimentation in the stratigraphic record is a major challenge in sedimentology and stratigraphy.

We are developing methodologies to understand ancient sedimentary deposits in terms of the sedimentation rates we know from modern environments.



Syn-rift border faults: architecture and flow

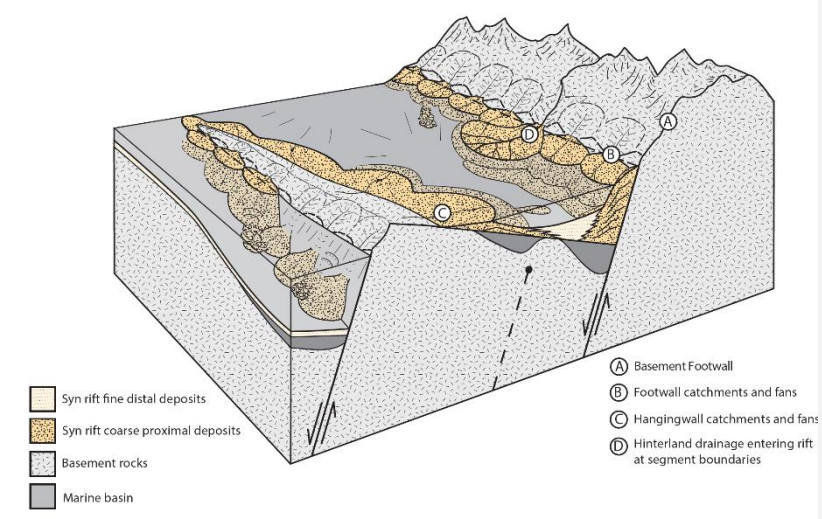
Project leader(s): Atle Rotevatn,

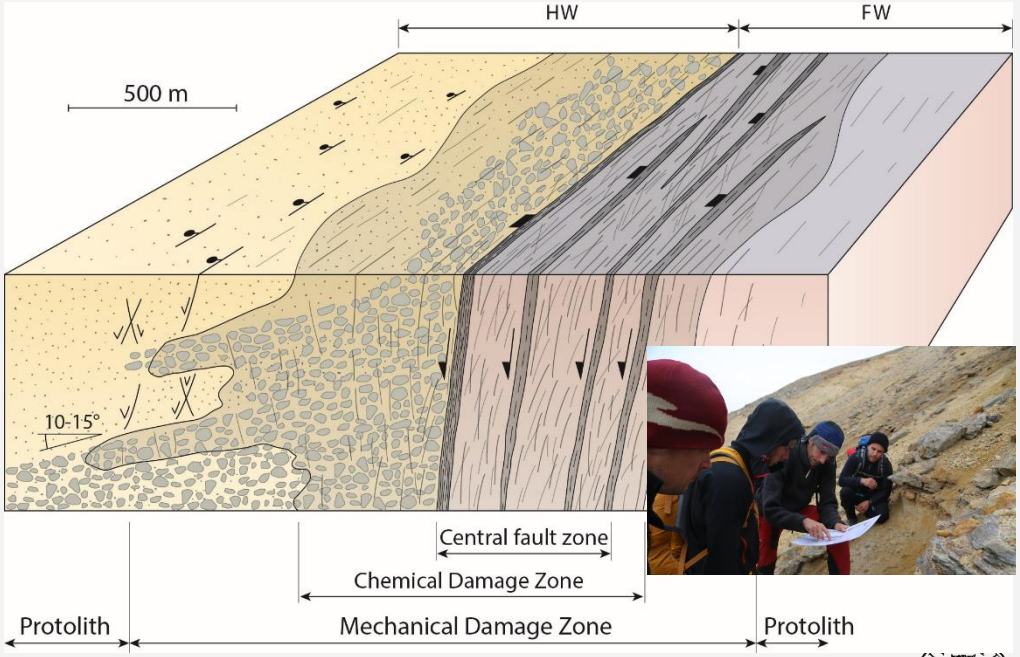
Project start date/duration: 2014 -

Personnel: T Kristensen, DCP Peacock, Rob Gawthorpe, H Fossen

Project Outline

- Aim: to characterize the structure and variability of major, basin-bounding normal faults and their associated damage zones
- Outcrop-based detailed fault zone characterization in East Greenland, Svalbard, Suez
- Implications for fault seal/leakage, migration





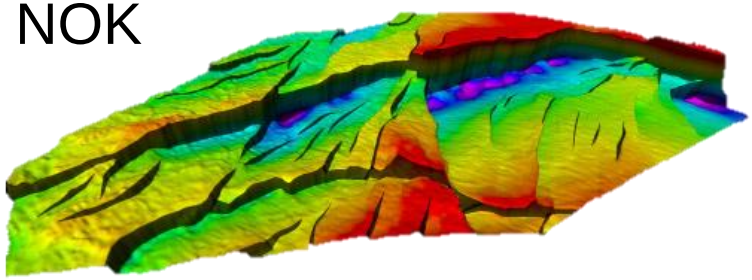
MultiRift Project

Project leader(s): Rob Gawthorpe + Co-I from Imperial, UoM + UiO

Project start date and duration: 01/08/2012 – 31/12/2016

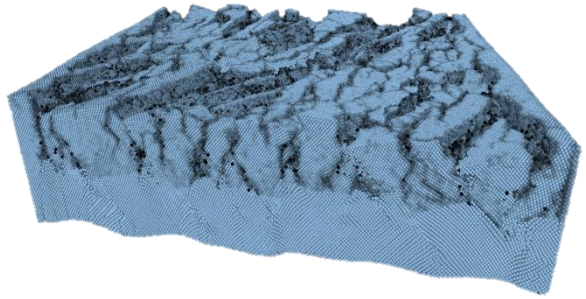
Funding: PETROMAKS + industry; 24m NOK

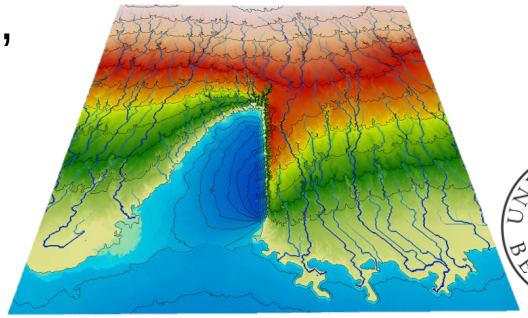
Personnel: 4 postdocs and 5 PhDs



Project Outline

- Overall aim is to develop a fundamental understanding of how pre-existing structures in both basement and cover influence the evolution of normal fault segments and fault networks in multi-phase rifts
- To determine the role of pre-existing structures in controlling rift topography, sediment sources, major sediment transport pathway
- To quantify the effects of erosion, deposition and mass redistribution at the Earth's surface on fault evolution and rift basin morphology





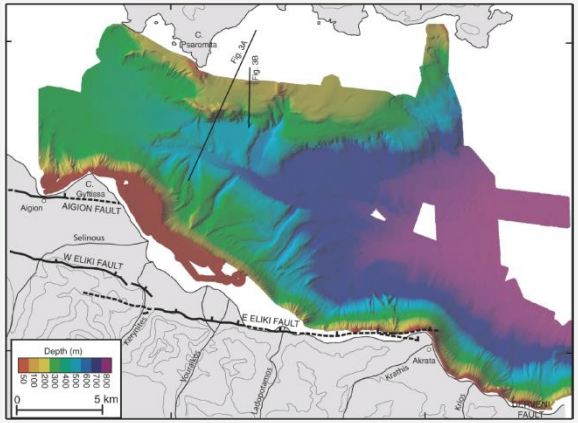
Syn-Rift Plays Project

Project leader(s): Rob Gawthorpe + Co-I from UEA, UoL, UoA, UdL

Project start date and duration: 01/01/16 – 31/12/19

Funding: PETROMAKS 2 + industry; 26m NOK

Personnel: 2 postdocs and 3 PhDs

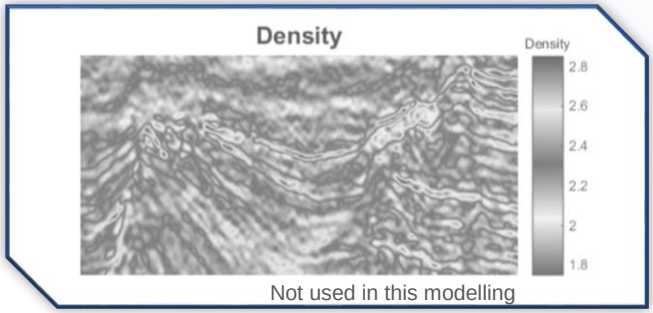


Project Outline

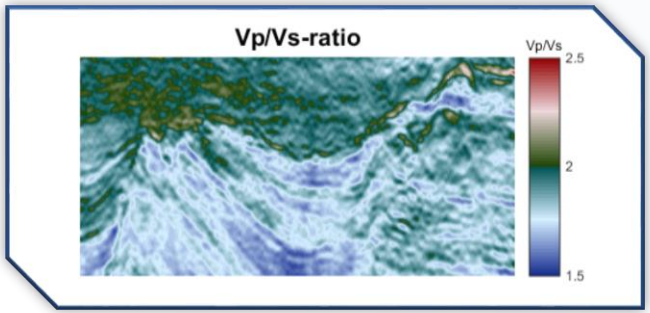
- Overall aim is to increase understanding of processes controlling location, geometry and stratigraphy of syn-rift reservoirs and elements of subtle syn-rift plays in rift basins. Focus on:
  - Shoreline depositional systems
  - Deep-water depositional systems
- Outcrop analogues and shallow cores from the Corinth Rift provide quantitative datasets on location, geometry and heterogeneity of these systems and controlling processes
- Apply to case studies of syn-rift plays on the NCS

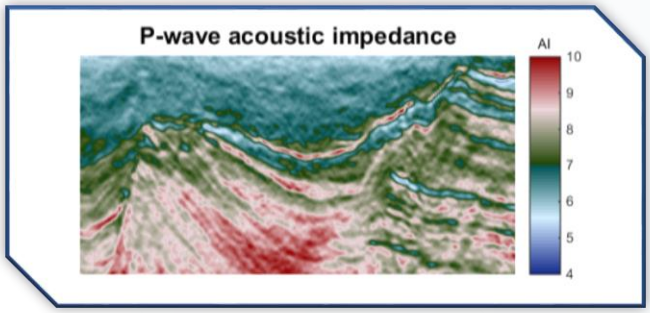
Seismic reservoir characterization – inverted data:

SEISMIC INVERSION DATA
One or more properties used as input to IRPM.



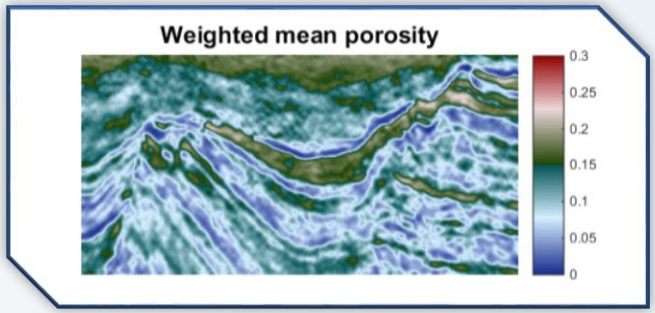
Not used in this modelling

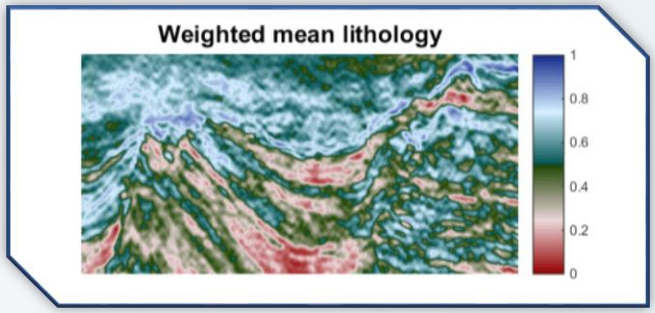


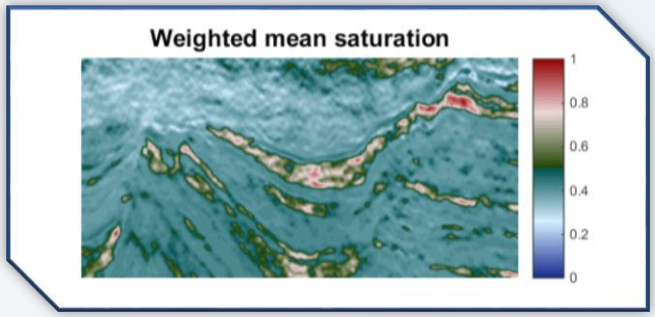


IRPM

IRPM PREDICTIONS
Predictions weighted by how well the model fits the data.







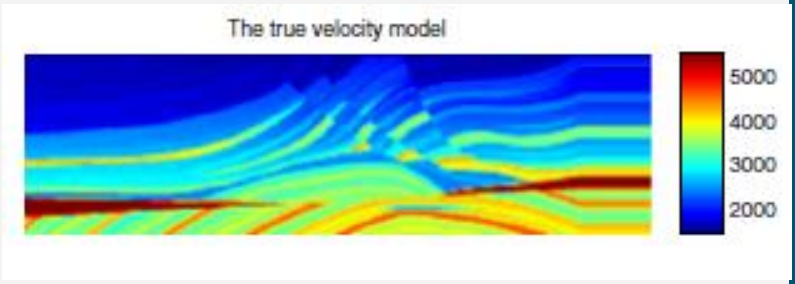
PI: Tor-Arne Johansen

Inversion of seismic waveform and CSEM data

Project leader: Morten Jakobsen.

Project duration: 2014-2017

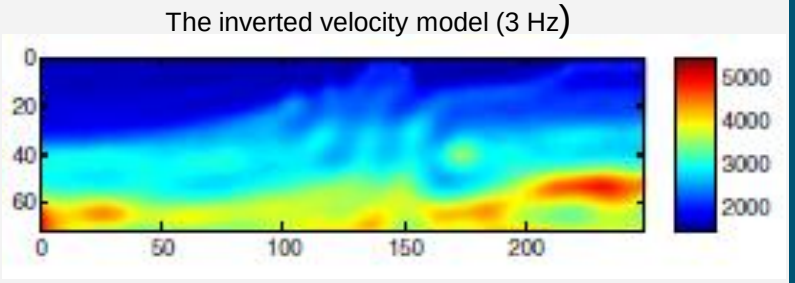
Funding: NFR, Petromaks2

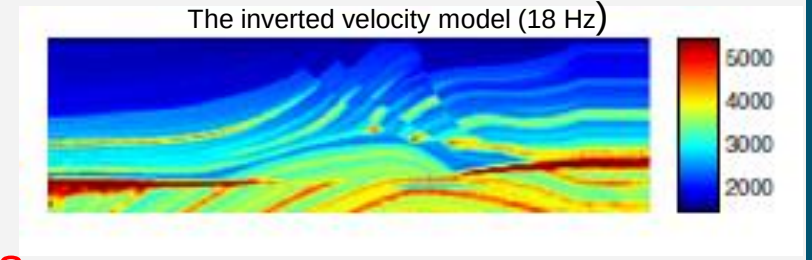


PI's: Morten Jakobsen (UoB), Trond Mannseth (Uni Research)

Researchers: Alena Ayzenberg (UoB), Svenn Tveit (Uni Research)

Aims: Develop integral equation methods for modelling and inversion of seismic waveform and electromagnetic data; joint inversion.





Selected publication:

Jakobsen, M. and Ursin, B., 2015.

Full waveform inversion in the frequency domain using direct iterative T-matrix methods.

Journal of Geophysics and Engineering,12, 400-418.

Opportunities with FORCE

NORSALT

STRATIGR… SEQUENCE IN
THE S… TROLEUM

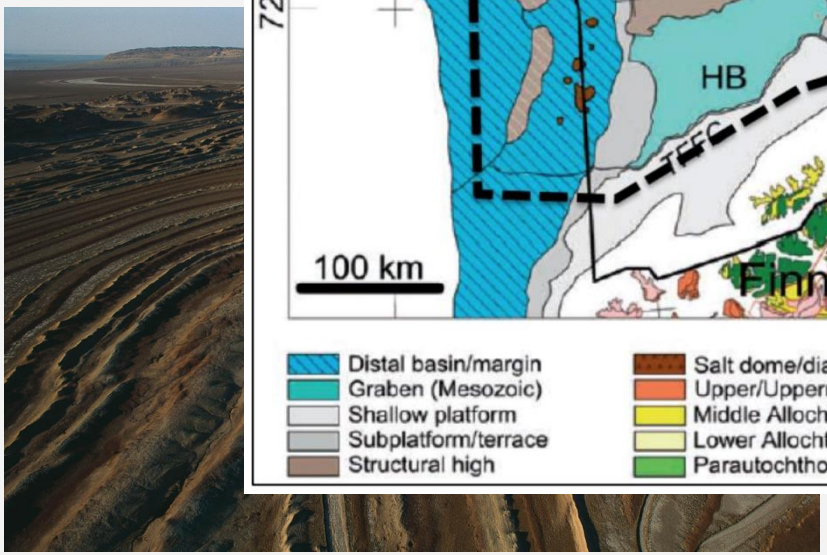
PIs: C.A.L… …s (UTEP)

Funding:

Research… …salt expertise

Duration…

LES …



Jackson et al. 2015