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
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 interpretation, visualization, reservoir modelling and flow simulation

- Field equipment
  - Marine and terrestrial seismic acquisition
- Marine infrastructure
  - Including vessels, seismic equipment, ROV
KEY AREAS OF RESEARCH
Key research areas
- Quaternary Earth Systems

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

2 post docs
12 PhD candidates
34 Master students
Key research areas - Geobiology

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

8 PhD candidates
10 Master students
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

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

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

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

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)
Seismic acquisition and processing

Marine 2D
OBS
Onshore

Particular focus on polar regions
Svalbard
Barents Sea
Example projects
Understanding the time represented by siliciclastic sedimentary deposits

**PhD student:** Tore Aadland  
**Project start date/duration:** 2014-2017  
**Supervisor:** William Helland-Hansen

**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.

- **Density**
- **Vp/Vs-ratio**
- **P-wave acoustic impedance**

- **Weighted mean porosity**
- **Weighted mean lithology**
- **Weighted mean saturation**

**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:**
Opportunities with FORCE
Petroleum Geoscience

Institutt for geovitenskap
Department of Earth Science

NORSALT

STRATIGRAPHY AND TECTONIC EVOLUTION OF A LAYERED EVAPORITE SEQUENCE IN THE SOUTHERN NORWEGIAN BARENTS SEA: IMPLICATIONS FOR PETROLEUM SYSTEMS DEVELOPMENT AND PROSPECTIVITY

PIs: C.A.L. Jackson (ICL), M. Rowan (RC), A. Rotevatn (UiB) & K. Giles (UTEP)

Funding: JIP through FORCE, currently seeking funding

Researchers: 3 PostDoctoral Researchers + access to world leading salt expertise

Duration and cost: 2 years, 9.2 MNOK split across sponsors

LES stratigraphy
LES tectonic evolution

Jackson et al. 2015

Photo: George Steinmetz