GEOLOGICAL SURVEY OF NORWAY

- NGU -

JOINING FORCES

Odleiv Olesen, Team leader Contiental Shelf Geophysics

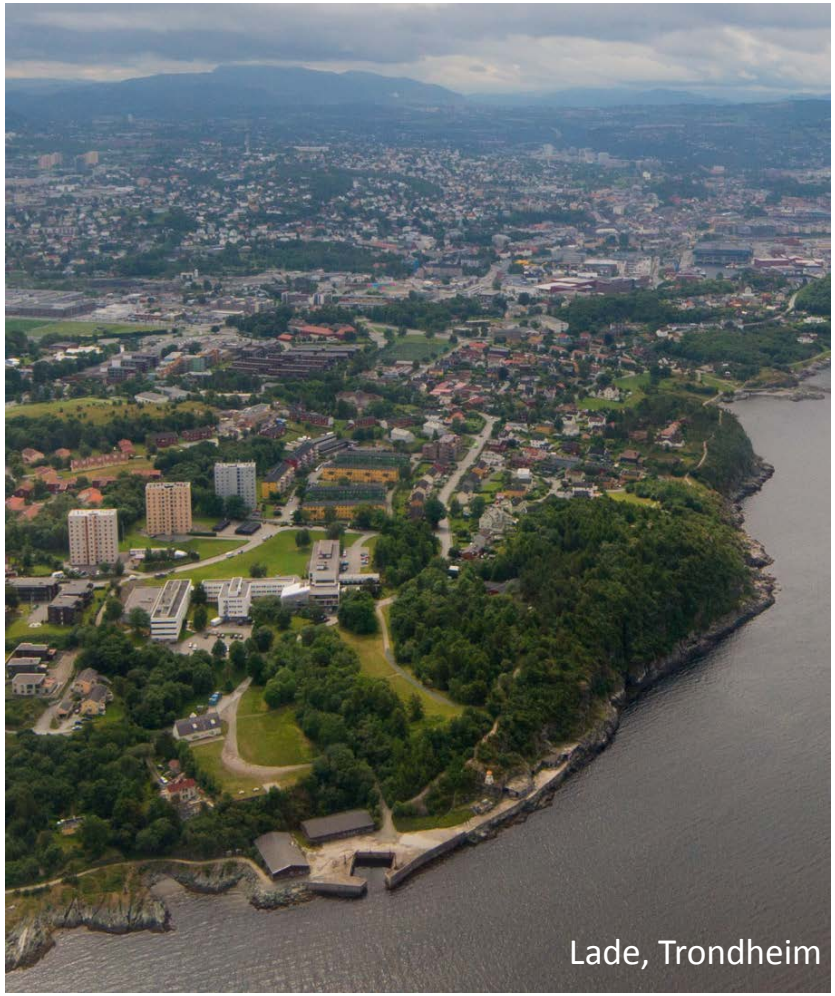
Force seminar, 03.02.2016, NPD Stavanger

Geological Survey of Norway
Geoscience organisation

Managing director
Morten Smelror

Georesources Director Tom Heldal	**Geoenvironment** Director Jan Cramer	**Geomapping** Director Øystein Nordgulen
Industrial minerals and metals Henrik Schiellerup	**Marine Geology** Reidulv Bøe	**Bedrock Geology** Bernhard Bingen
Natural Construction Materials Kari A. Aasly	**Groundwater and Urban Geology** Hans de Beer	**Quaternary Geology** Astrid Lysså
Applied Geophysics Jan. S Rønning	**NGU-Laboratory** Ana Banica	**Geodynamics** Susanne Buiter
Geochemistry Berlinda Flem		**Geohazards** Reginald Hermanns
		Continental Shelf Geophysics Odleiv Olesen

220 employees



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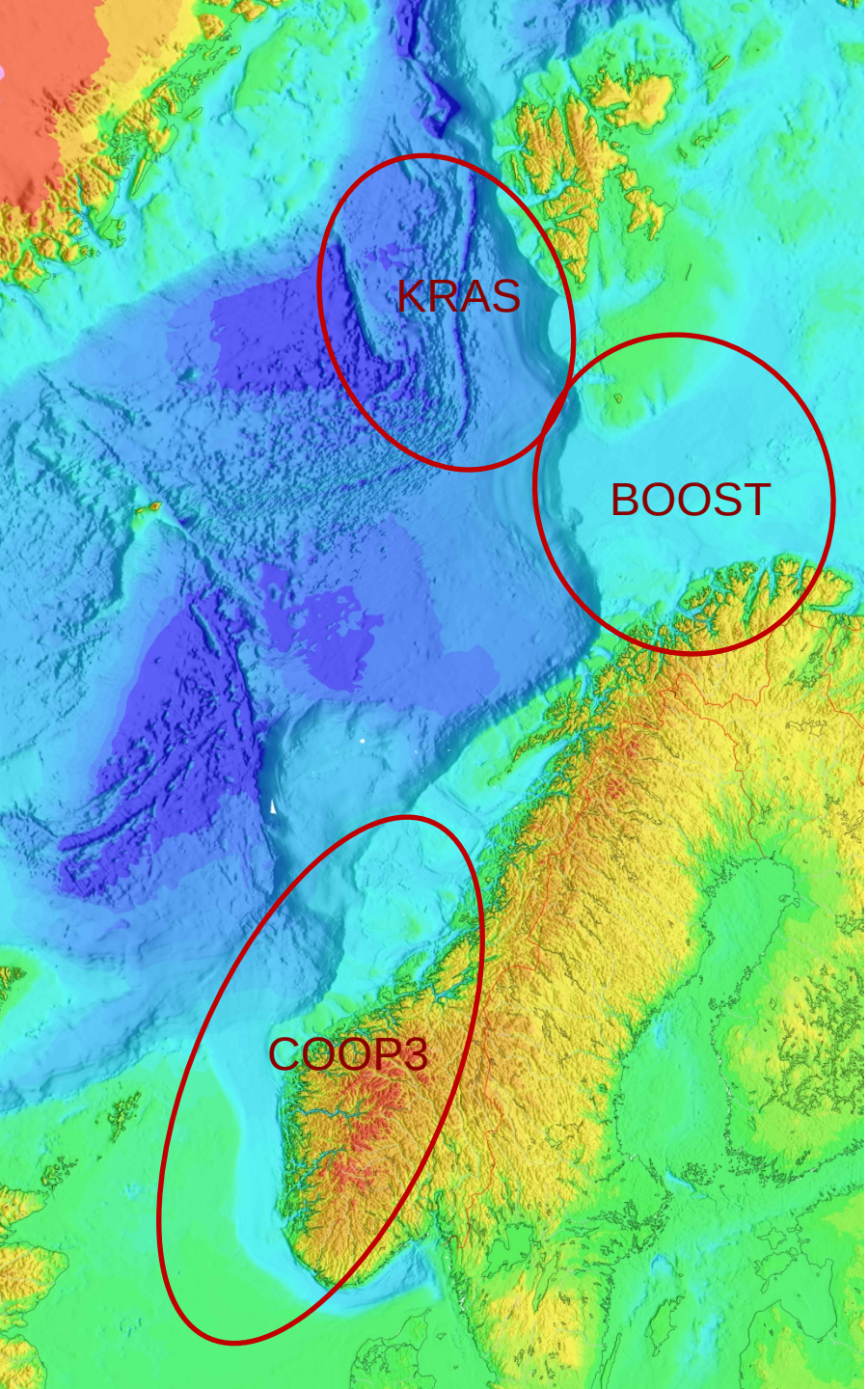

New research projects at NGU

BOOST	Barents Onshore-Offshore Structural and Thermal Modelling
COOP3	Crustal Onshore-Offshore Project 3
NAG-TEC2	Northeast Atlantic Geoscience Tectono-stratigraphic Atlas 2
BASE2	Petroleum in weathered and fractured basement 2
KRAS	Knipovich Ridge Aeromagnetic Survey

Aeromagnetic data

bayerngas

centrica energy

ConocoPhillips

DEA

DETNORSKE

DONG energy

Eni Norge

GDF SUEZ

Lundin Petroleum

MAERSK OIL

NORECO

REPSOL

Statoil

SUNCOR ENERGY

TOTAL

VNG Norge

wintershall

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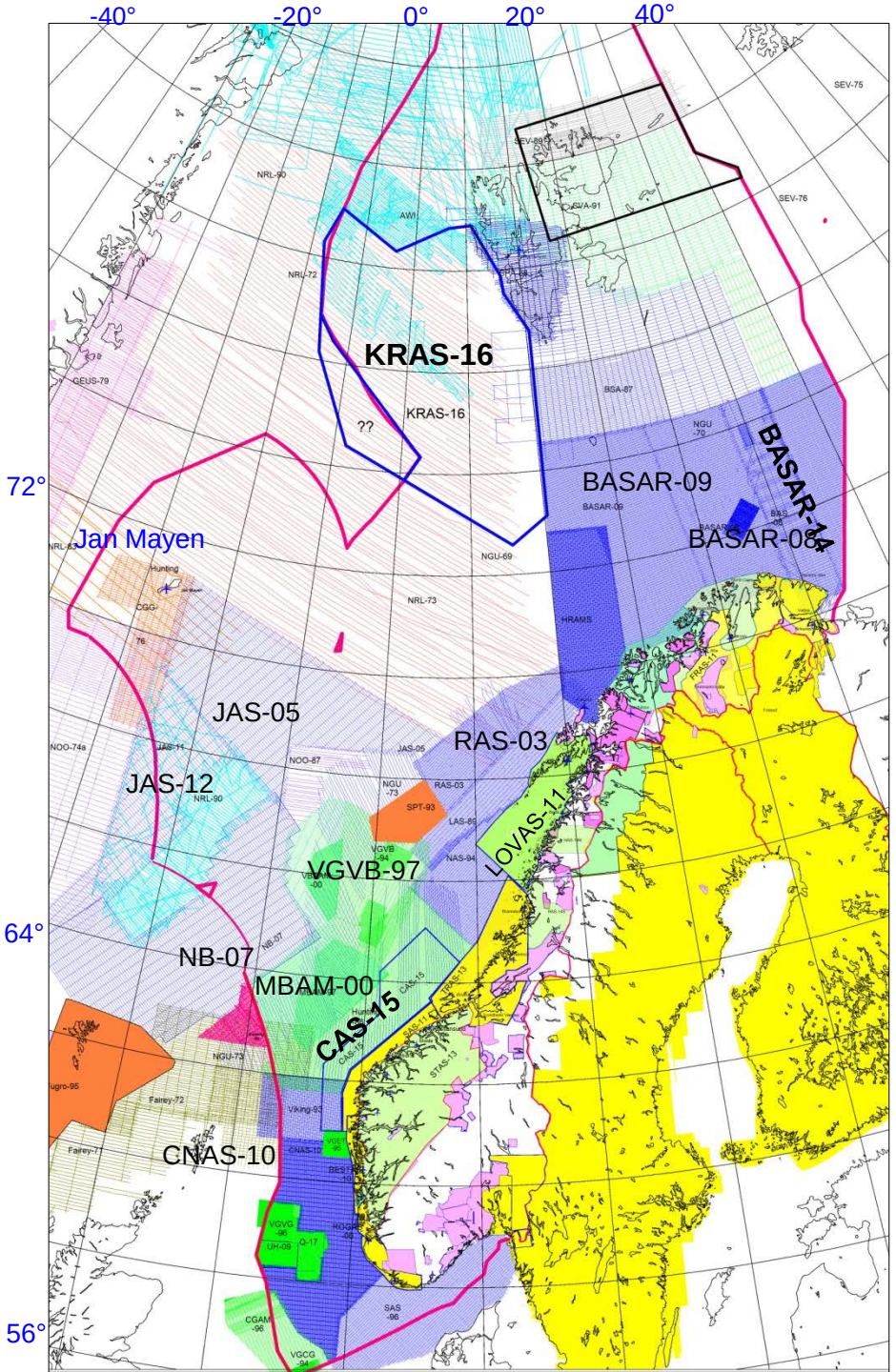
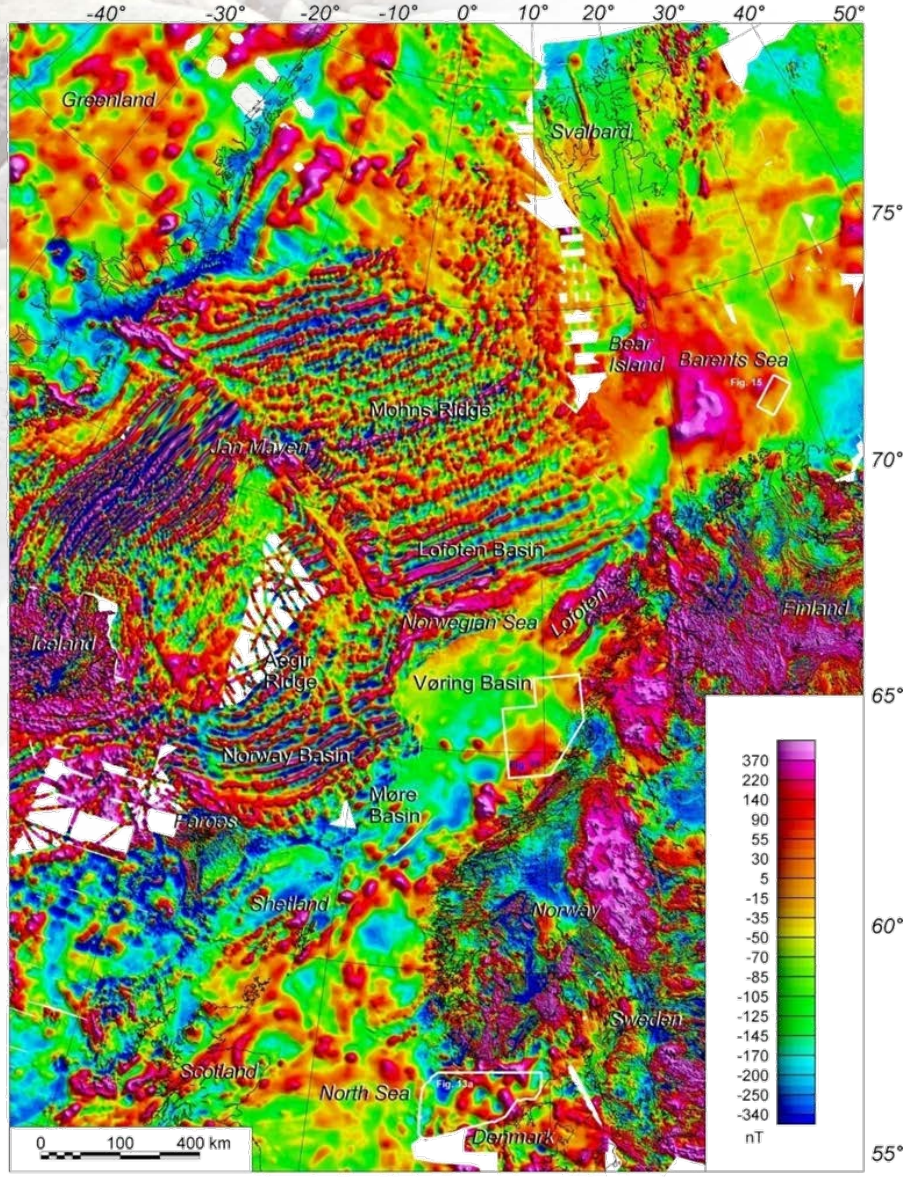
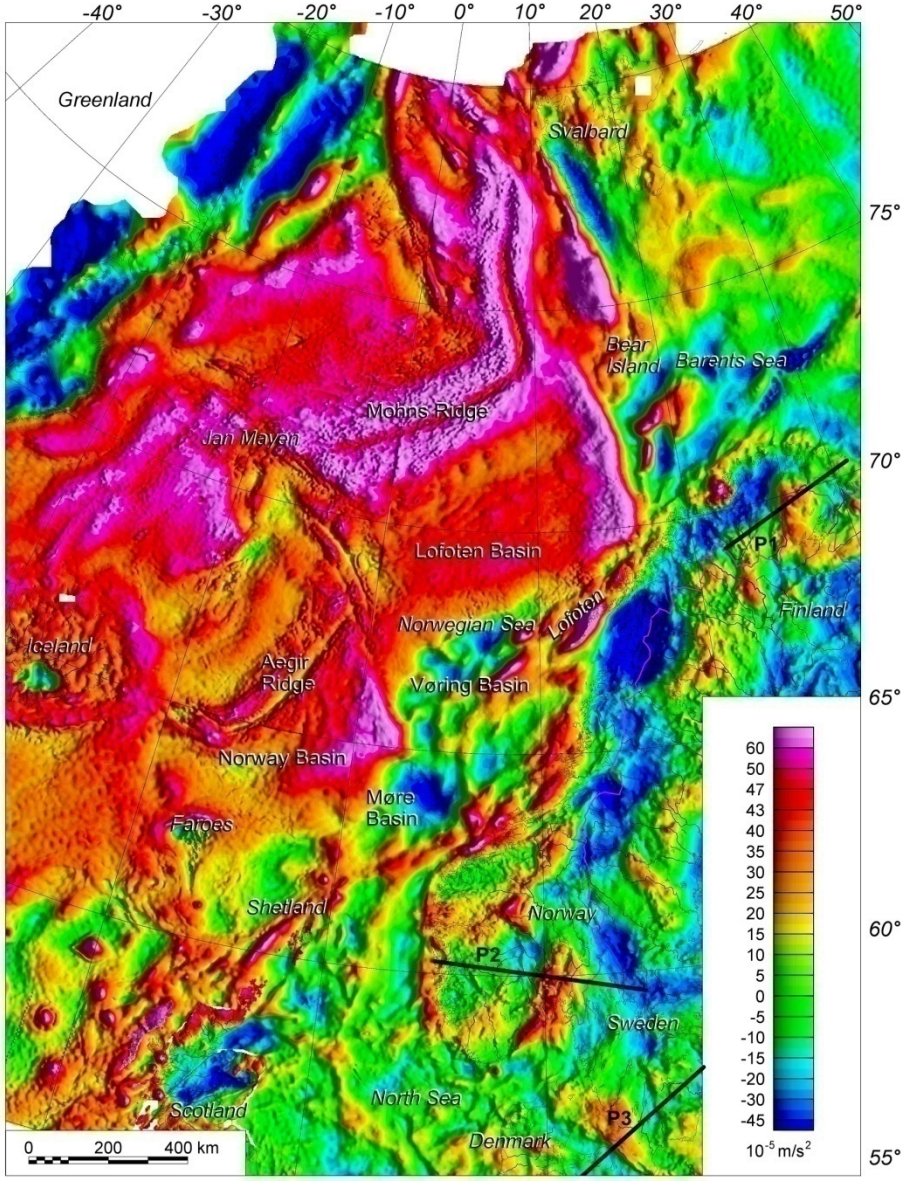
NORWEGIAN PETROLEUM DIRECTORATE



Aeromagnetic compilation



Gravity compilation Isostatic residual



Coop
Crustal onshore-offshore projects

Main objectives

- Basement characterization
  - Heat production
  - Lithology
  - Deep weathering
- Depth to basement
- Fault zones (onshore-offshore)
- Dyke swarms
- 2D & 3D crustal modelling
- 3D thermal modelling
- Geodynamic and tectonic interpretations

- Subcrop pattern
- Quaternary sand channels

coop
litt dit

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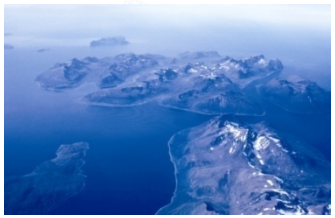
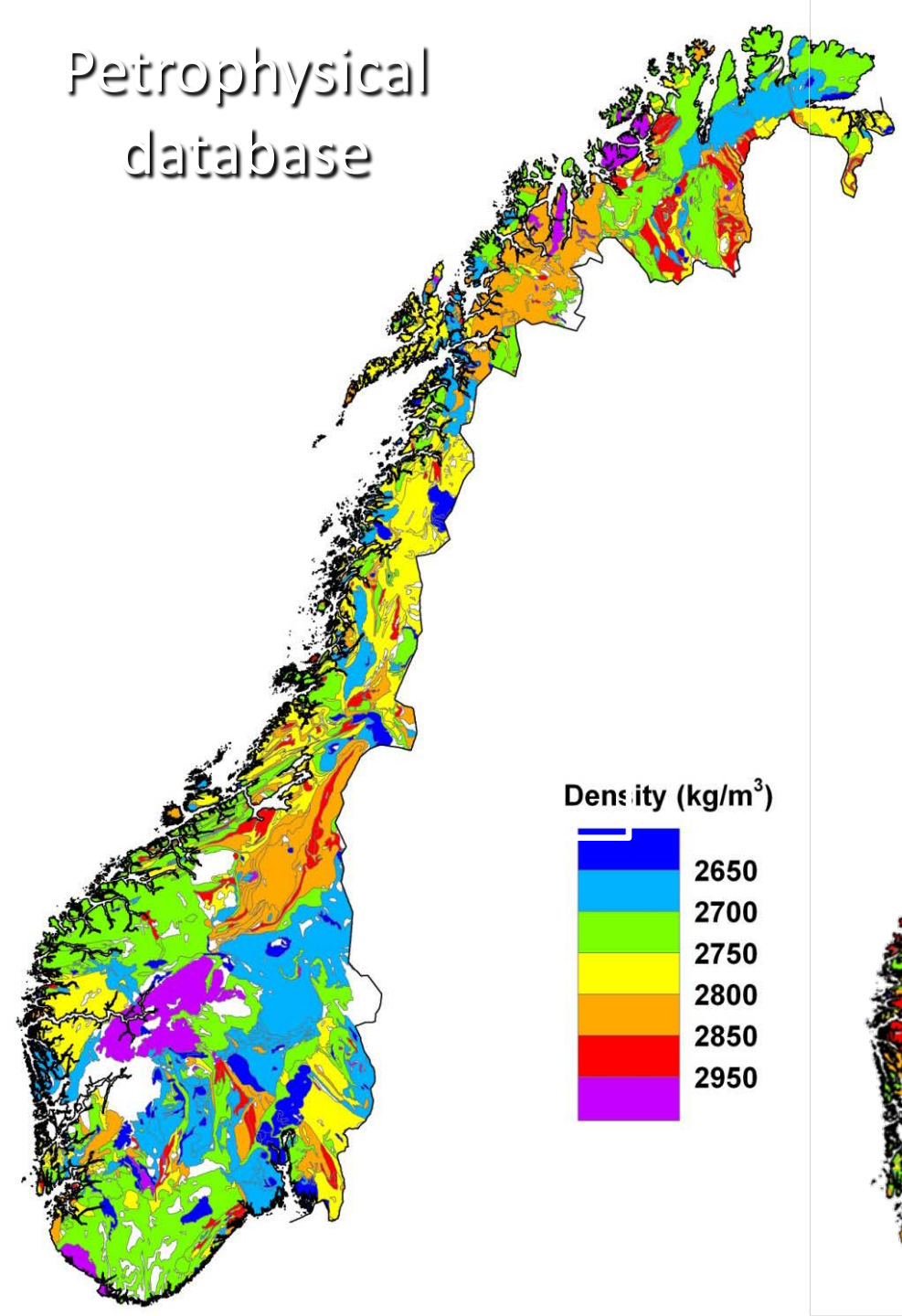
Petrophysical database

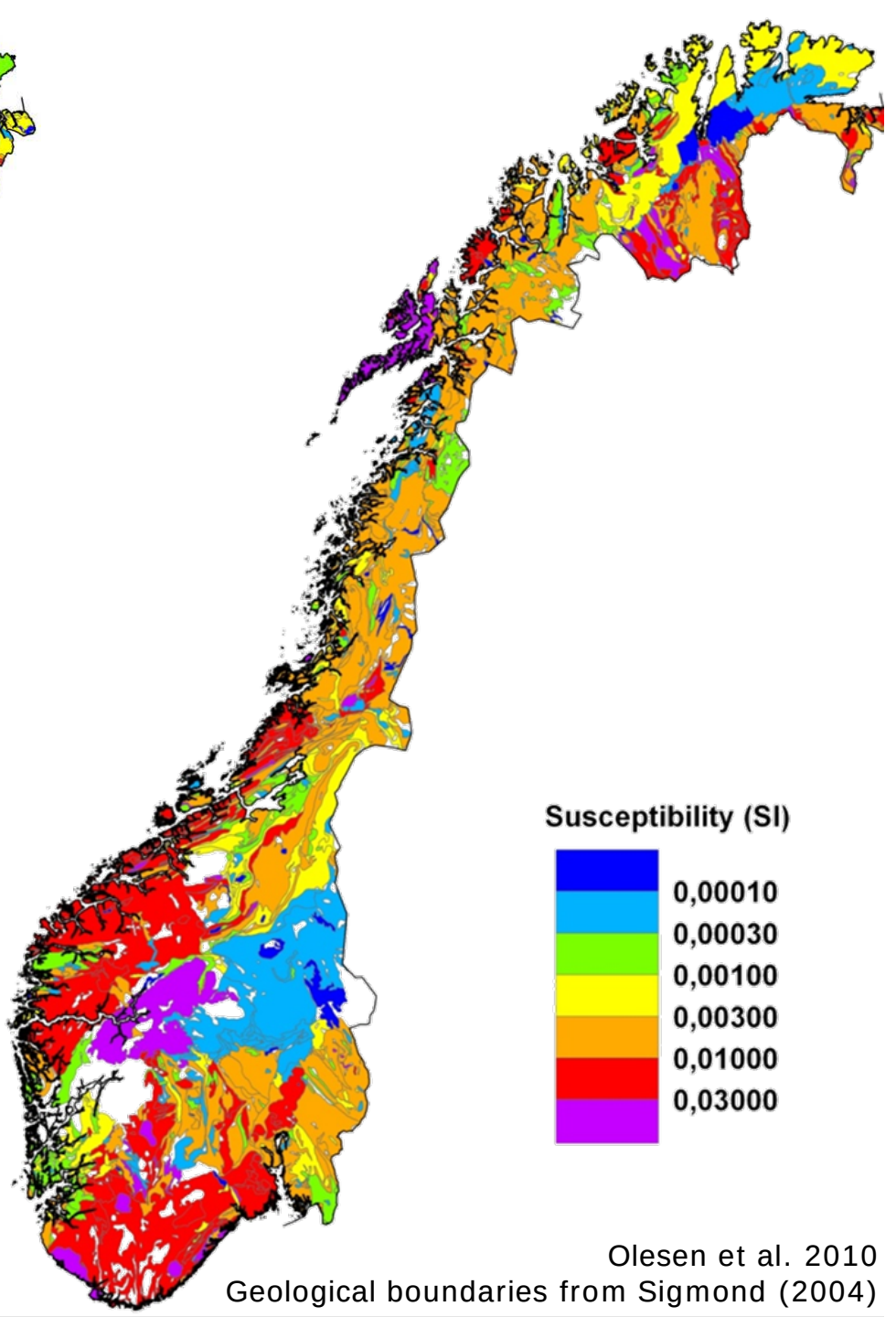


Density
kg/m^3

- 1514 - 2652
- 2653 - 2723
- 2724 - 2802
- 2803 - 2895
- 2896 - 2996
- 2997 - 3125
- 3126 - 3335
- 3336 - 4583
- 4584 - 6617

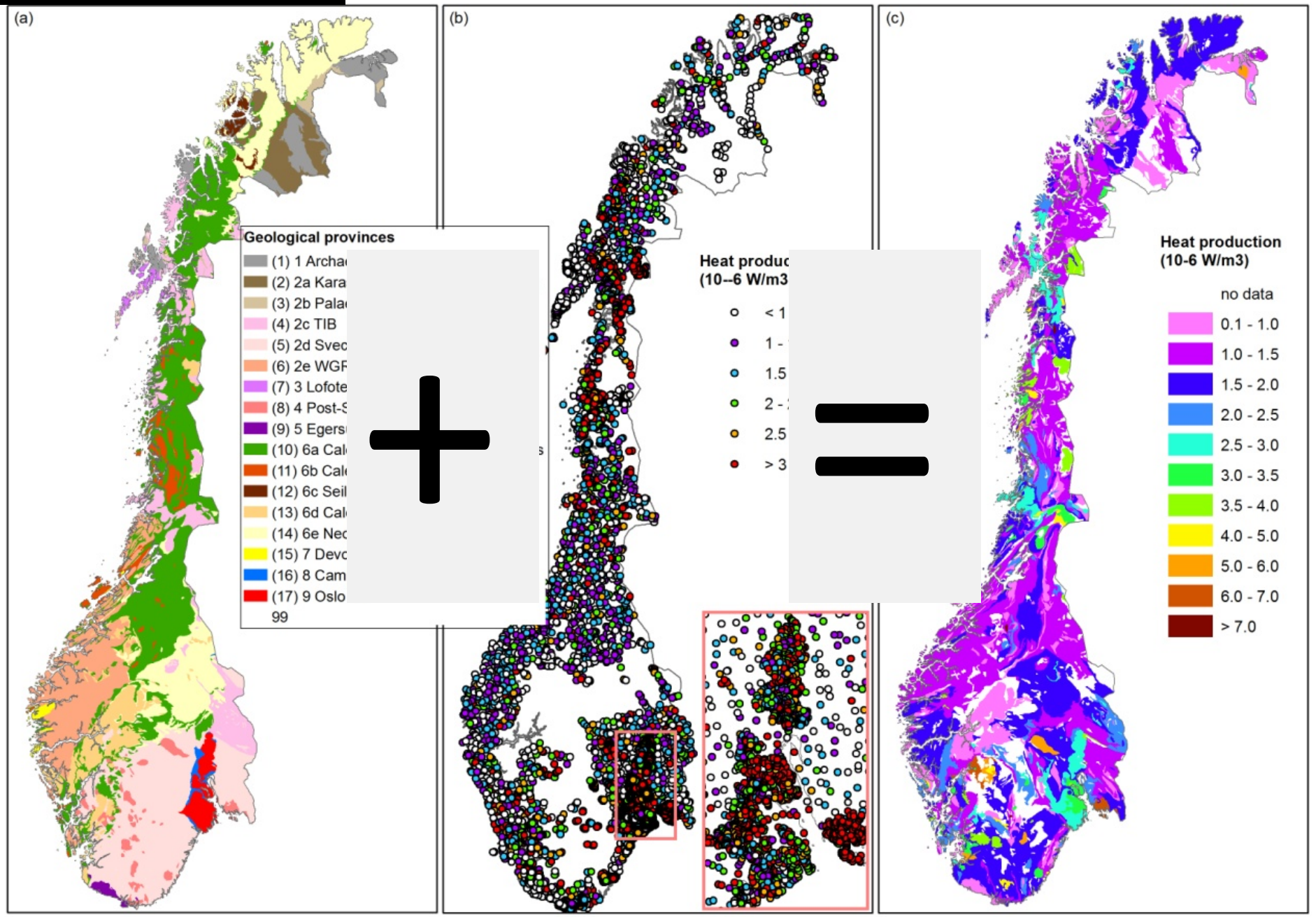
Petrophysical database





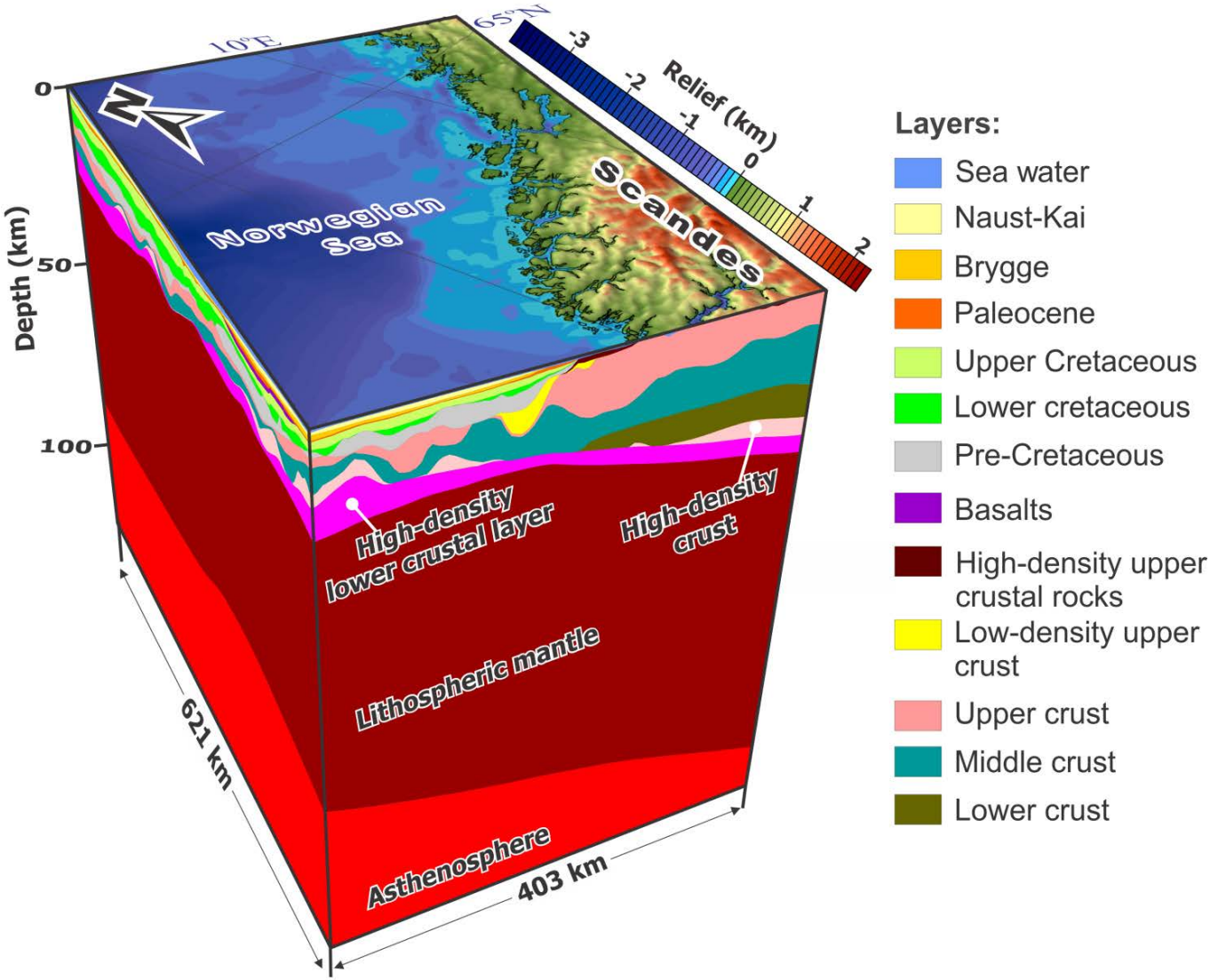
Olesen et al. 2010
Geological boundaries from Sigmond (2004)

Determining heat production



Slagstad 2012

3D density/structural model



Maystrenko & Gernigon 2015

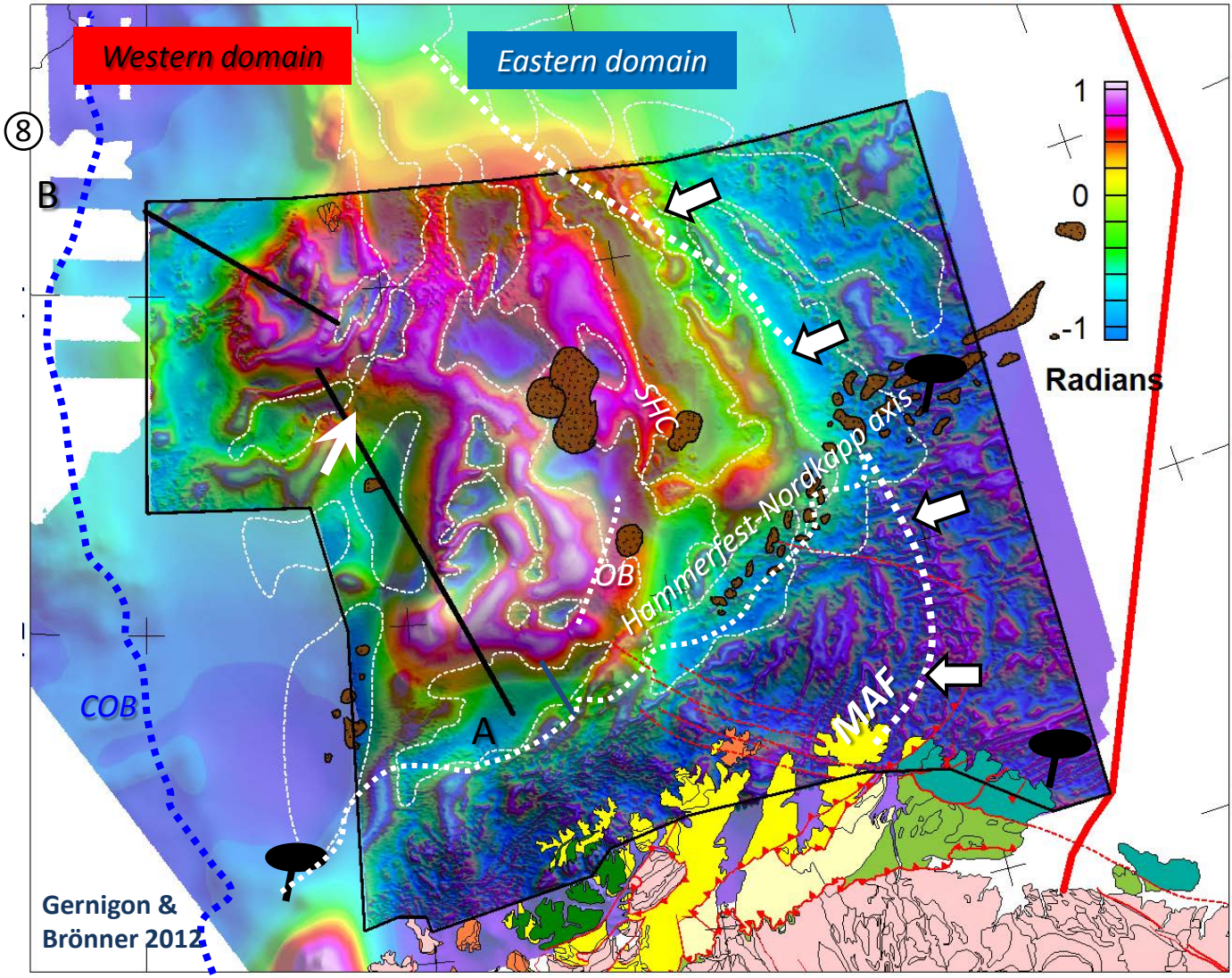
Deep weathering analogues in the Ukrainian Shield

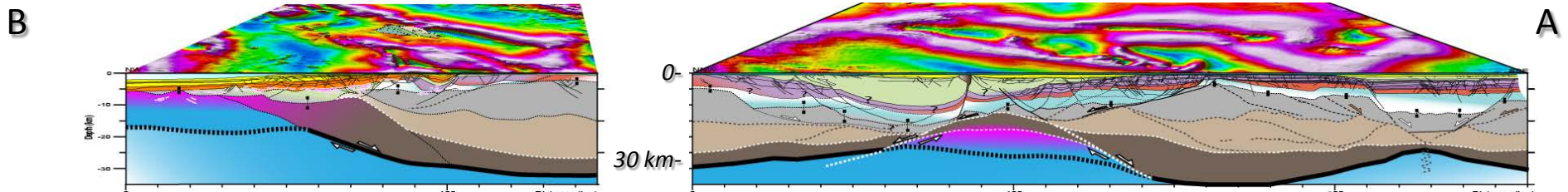
Granite quarry beneath deep weathering, Donetsk, (Rose of Azov granite)

Borehole samples of deep weathering in Ukraine; limonite, silcrete, soap stone and clay containing kaolinite, smectite and hyalite.

BOOST - Barents Onshore-Offshore Structural and Thermal Modelling

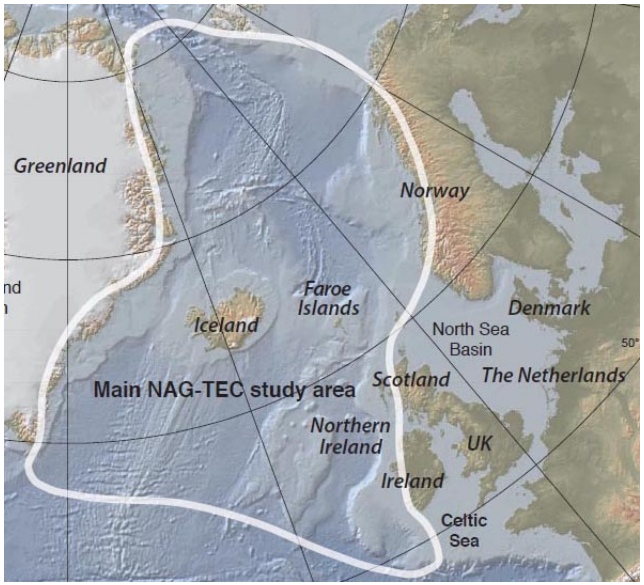
- Coastal aeromag. survey
- Core drilling, Bjørnøya
- 3D crustal modelling
- 3D thermal modelling
- Geodynamic and tectonic interpretations

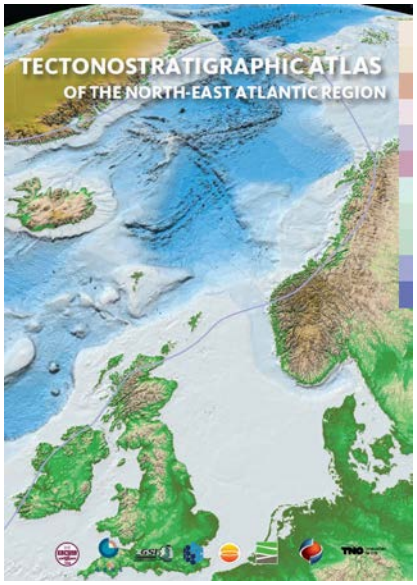




NAGTEC2:

Northeast Atlantic Geoscience - Tectonic Development Theme – PHASE 2





The development of the North-East Atlantic :

- from orogenic collapse (early-rift margin evolution),
- to the main extensional phases (structural and stratigraphic rift development),
- to breakup and active spreading (post-rift evolution)

Full Proposal available on demand. Contact:

Gwenn Peron-Pinvidic – gwenn@ngu.no

http://www.geodynamics.no/

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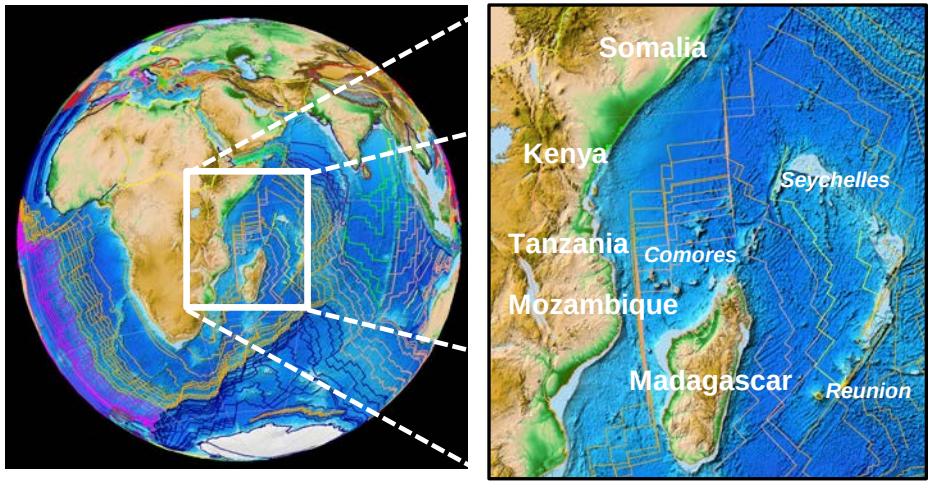
TEAM: The East-Africa – East Antarctica/Madagascar rift system:
influence of opening kinematics on rifted margin architecture



Reappraisal of the rift system in the light of new rifting concepts:

- Plate Kinematics (GPlates)
- Offshore Investigations (Detailed seismic interpretations)
- Dynamic Modelling (Numerical and Analogue)

Full Proposal available on demand. Contacts:

Gwenn Peron-Pinvidic – gwenn@ngu.no
Susanne Buiter – susanne.buiter@ngu.no

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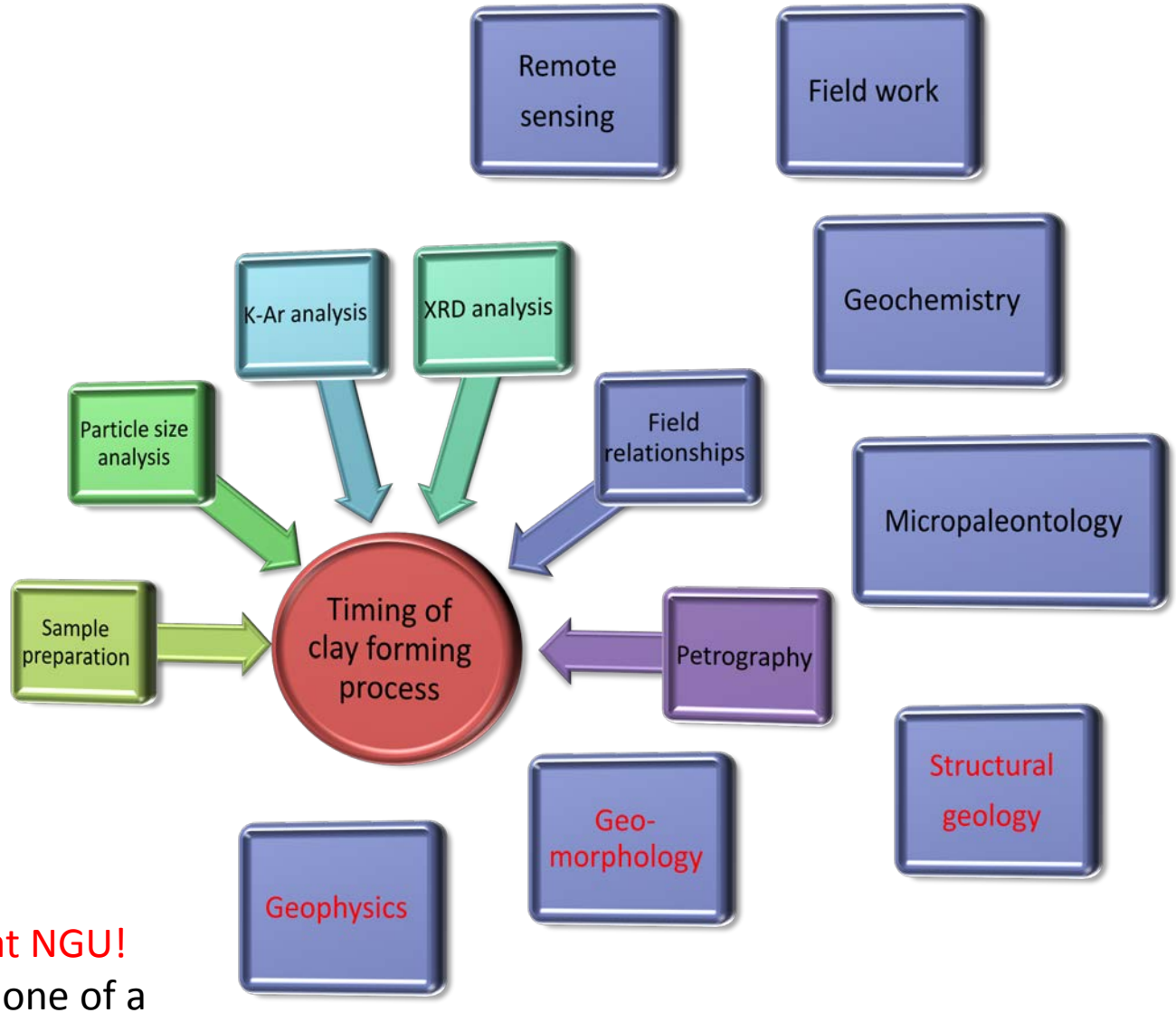
SFI – Petroleum Potential in Weathered and Fractured Basement

Initial ideas/concept

SFI

Unique conceptual and scientific approach (relevant to the industrial world!):
Dating landscapes and brittle deformation as part of a joint scientific effort!



Unique analytical toolbox at NGU!
State of the art laboratory, one of a kind in Europe. Room for improvement, synergy with Ar/Ar lab, new SEM, cooperation with nanolab at NTNU.

Uniquely multi-faceted team with nicely integrated expertises.

Contact: Jochen Knies (jochen.knies@ngu.no)

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6407/10-3

From Drilling report :

Basement:

Granite: pink to light red
…common hematite veinletes and hematite coatings
to fracture surface

Sedimentary rocks:

…basal part of the Triassic is characterised by increasing frequency of derived lithic fragments.
…Kaolinite, white blocky to angluar, moderately hard.
(pers. comm. J.A. Øverland), NPD

NORWEGIAN PETROLEUM DIRECTORATE

NGU's projects on deep weathering

TWIN – onshore

↓

RAMSÅ – basement high

↓

COOP – strandflat

↓

BASE – timing

Why a SFI: The Rationale

- **One common scientific goal of relevance to NGU, the partners and the national/international scientific community :**
  - An integrated Earth-Science expertise platform for the development and implementation of innovative tools that maximize hydrocarbon exploration success rates in fractured and weathered basement offshore Norway (including the Barents Sea).
  - A new toolbox to date landscapes – ”hvordan ble landet til?”

- **Implemented through :**

An overarching research initiative of broad interest capable of producing individually-targeted solutions for each partner.

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Why a SFI: The Rationale

- **Resulting in:**

- Innovation and value creation in the studied fields

-Powerful synergies between innovative companies and prominent research groups

-High quality scientific research

-First-class international cooperation

-Recruitment of talented researchers

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SFI– What?

- Apply/develop/refine innovative conceptual and exploration tools for offshore hydrocarbon prospection in basement highs and nearby basins.

- Refine understanding of offshore plays through detailed analysis of onshore analogues.

- Establish a spatial and temporal framework for multiple episodes of deep weathering and faulting on- and offshore.

- Provide templates for improved exploration success rates.

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More Information?

Contact: Jochen Knies (jochen.knies@ngu.no)