

# Trias North

## newsletter

News from the research project

Reconstructing the Triassic northern Barents shelf:  
basin infill patterns controlled by gentle sags and faults

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### New paper on the Triassic Snadd Formation

## Regional development and sequence stratigraphy

Trias postdoc **Tore Grane Klausen** and co-workers have just published an article on this topic in *Marine and Petroleum Geology*. We quote the article's abstract:

The Middle to Late Triassic Snadd Formation represents one of the later stages of Early Mesozoic infilling of the Barents Sea Basin, expressed by a siliclastic wedge prograding from the southeast, where sediments were shed from the Uralide Orogeny. The formation was deposited in a shallow (100–500 m) basin facing the Boreal part of the Panthalassa Ocean, and the progradation reached its peak at the Svalbard Archipelago which has since been uplifted and where outcrops are exposed as the timeequivalent Botneheia and De Geerdalen formations. The Snadd Formation includes depositional environments ranging from offshore shale through shallow marine to fluvial, arranged in discrete stratigraphic sequences.

Here we present a refined sequence stratigraphic framework for the Snadd Formation. Two second order sequences have been interpreted within

the limits of the study area, divided into six third order sequences. The two second order sequences are split along an Intra Carnian maximum flooding surface. Depositional elements inherent to the sequence stratigraphic framework are also interpreted and extrapolated so as to describe the regional distribution of potential reservoir sandstones and the control exerted on the development of third order sequences.

Different depositional environments from various datasets and scales of observation show the progressive development of a prograding delta across more than 700 km from a proximal position on the Finnmark Platform to a distal position on Edgeøya. Regional correlation of well logs and 2D seismic coupled with detailed depositional environment interpretation from 3D seismic and core has resulted in basin-wide palaeogeographic reconstruction of the formation throughout the Norwegian part of the Barents Sea, with implications for understanding the distribution and evolution of depositional systems during this large-scale basin infill.

<http://dx.doi.org/10.1016/j.marpetgeo.2015.02.004>



### Main Trias events in 2015:

- June 1<sup>st</sup>–3<sup>rd</sup>: Partner meeting in Oslo: *Datasharing summit*.
- Field work at Svalbard tentatively August 18<sup>th</sup> – 31<sup>st</sup>.

## Excerpts from the Trias North Work Plan 2015

# Things we hope to get done ...

### **2D seismic mapping**

The plan is to focus on constraining the regional geology by focusing on two areas, one of which will be the Stappen High, which is a key in understanding the development of the northern part of the shelf.

### **Provenance of reservoir sandstones**

We will continue the provenance studies of siliciclastic facies belonging to the Triassic sedimentary succession of Svalbard, on the basis of the results of petrographic (optical microscopy, SEM and CL techniques) and geochemical analyses. The subject of the research will be mostly sandstones representing the Karentoppen and Somovbreen Members of the Bravaisberget Formation.

### **Fluvial seismic geomorphology**

Targets are to formalize, present and publish work on decompaction of sedimentary systems, with an emphasis on clinoforms. At the next stage these results will be used on clinoform datasets from the SW Barents Sea, to see if new learning can be gained. Of special interest is the quantification of clinoform geometries as such parameters may inform our understanding of the associated sedimentary system.

### **Sedimentary facies belts and regional variability**

We will sample cores from Snadd and Kobbe formation at NPD's core store, and perform detailed sedimentological study (logging) from De Geerdalen Formation and Wilhelmøya Subgroup at Svalbard. Furthermore, we will look for possible analytical methods to construct thermal burial history to understand the effect of uplift on diagenetic alteration and reservoir quality.

### **Did Triassic faulting halt regional clinoform progradation?**

Work is focusing on linking observations of the offshore seismic data to onshore logs on Edgeøya based on our current understanding of clinoforms and deltas in shallower water. Additionally, we will be focusing on the Triassic large-scale development of Edgeøya.

### **3D photometric models**

We will continue with the photogrammetric processing, and we need to complete some development work to ensure transition between the photogrammetric software output and our regular lidar workflows. The textured 3D outcrop models when finished will be

handed over for geological work. At this stage marker beds will be traced out and stratigraphic logs placed into the model for further analysis, spanning across to the study of low-angle clinoforms on structural highs, clinotheme architecture and related sedimentary facies.

### **3D photometric models and strip-logs**

Datasets from two field campaigns (2012 and 2014) with extensive logging in many half-grabens spanning across to facies interpretation are currently compiled for publication.

### **Faults analysed for deformation mechanism and sealing potential**

Our work on characterizing faults in poorly consolidated sediments divides into two phases. Phase 1 will focus on the analysis and interpretations of the dataset collected during the 2014 field campaign Phase 2 will be dedicated to the analysis of the 2015 data and to implement the total structural-stratigraphic database.

### **Shale detachments**

Extensive data has been collected through two field seasons, and are currently processed towards a summary. These results will be coordinated with the other fault studies.

### **Synthetic seismic modelling of the facies belt**

The work uses seismic modelling software of NOR-SAR proprietary, commercial and prototypes, especially a PSDM simulator (see proposal for details). At the moment the focus is on the Kvalpynten outcrop of Edgeøya. A better input model coming out soon will form the base for a more complete modelling that will be undertaken.

### **Structural style controlled by fault growth vs sediment loading**

In Parma, we will start the pilot model and complete the first series of preliminary experiments. The model set up has been discussed and modified in line with preliminary results and feedback from the partners. Later on, we will calibrate the model and the different scenarios along with the results coming from the preliminary experiments.

### **Decoupled fault-segment growth in mechanically layered successions**

Datasets are currently being processed.

## Trias North in the Emerging Leaders program

# The Future of the Final Frontier

*Emerging leaders* is a program which is run in conjunction with the *Arctic Frontiers* conference in Tromsø. This year our own postdoc **Ingrid Anell** had the chance to participate in the program as one of ten PhD/Postdocs from Norwegian institutions funded by the Norwegian research council. This is her report.

The program brought together 30 young people from a variety of backgrounds; geology, biology, oceanography, climate science, economy, business, management and politics. The group travelled together from Bodø via Svolvær and finally to Tromsø, where the exciting week-long event was rounded off with two days of policy at Arctic Frontiers. Along the way an eminent group of mentors joined, including embassy representatives, prominent scientists and leaders in industry and business. The week together was intense and exciting. The talks included sessions focused on politics and security in the high arctic, climate and energy, safety and maritime resources and business and society in northern Norway. But there was also room for some fantastic lunches and dinners, as well as cultural and social engagements like a high-speed boat safari around the Lofoten islands, and visiting an aquarium and a Viking museum.

The convergence of such an interdisciplinary group placed every discussion in a wider context. Every question was viewed from a social perspective, an economic perspective, an environmental perspective, a political perspective. The discussions and work highlighted the inter-disciplinary nature of the group and particularly the different considerations between science and society. Among several other topics, the

group discussed visions for the future energy mix in the Arctic, which naturally included the role of oil and gas. This discussion did not remain aboard Hurtigruten, however, as it also held a central role in the discussions throughout the policy session at Arctic Frontiers. At the opening session there was an armchair discussion about oil and gas in the Arctic, between a panel of people which featured both Greenpeace and royalty.

As a geologist you develop a unique sense of time and a unique view of the earth. Its evolution and development occur on a scale which is far beyond the human time-frame. Tectonic plates, outpourings of lava and volcanic gas, supercontinents, and snowball earth – all this can make anthropogenic influence seem almost petty. The earth, the rocks, our study area, will most certainly survive climate change. Species may not, but life will. As an academic, even when working with seismic data, wells and sedimentary rock, it is easy to take a neutral stand on oil and gas exploration. The academic role is simply to piece together the geological history.

It was therefore thought-provoking to be a part of the discussion and to hear others discuss these very pertinent questions. Questions, it became clear, which are without simple answers. Visions can be easily compared to the reality of the multiple factors which need to be taken into account when making decisions.



*The emerging leaders and their mentors at The Edge Hotel in Tromsø, all glammed up for the banquet.*

During the policy session at Arctic Frontiers prominent people from politics, business, environmental organizations, arctic governance and scientific advisors discussed issues related to climate and energy in the Arctic.

I found myself sitting between two ambassadors listening to the Prince of Monaco. This made Arctic Frontiers a little more intimidating than most conferences I had attended before.

Policy gave way to science sessions, however, and on Thursday I held a talk entitled *Bridging the*

*gaps of our understanding of the Triassic development of the northern Barents Shelf.* While Arctic

Frontiers was very enthusiastic, the organizers warned me of an audience of non-geologists and a need to keep things simple.

The presentation therefore became quite a general talk about how understanding the Triassic provides understanding of

source, reservoir and potentially seal on the northern Barents shelf. The talk was well met and it was a good challenge to present to an audience with a diverse background.

“What happens in the Arctic does not stay in the Arctic”

Robert Papp, US Special representative to the Arctic, speaking at Arctic Frontiers 2015

Emerging Leaders/ Arctic

Frontiers was a fantastic opportunity. Although almost overwhelming at times given the hectic schedule, sheer amount of information and intensity of conversation, it was truly a fulfilling experience. The group was diverse and stimulating and the mentors came with a wide variety of insight and guidance. I feel I had the chance to see things differently and meet some truly interesting people, many of whom are now not only contacts, but friends.

*Postdoc Ingrid Anell in Svolvær*



As registered in the [Cristin Research Database](#)

## Trias merits of 2014

- Osmundsen, Braathen, Rød, Hynne: Styles of normal faulting and fault controlled sedimentation in the Triassic deposits of Eastern Svalbard. *Norwegian Petroleum Directorate Bulletin*.
- Anell, Braathen, Olaussen: The Triassic – Early Jurassic of the northern Barents Shelf: a regional understanding of the Longyearbyen CO<sub>2</sub> reservoir. *Norsk Geologisk Tidsskrift*.
- Anell, Midtkandal, Braathen: Trajectory analysis and inferences on geometric relationships of an Early Triassic prograding clinoform succession on the northern Barents Shelf. *Marine and Petroleum Geology*.
- Gabrielsen, Braathen, Skar: Normal Faults in Sedimentary Rocks; Dynamics, Architecture and Influences on Fluid Flow. Conference on Geometry and Growth of Normal Faults.
- Ogata, Anell, Braathen, Osmundsen, Smyrak-Sikora, Husteli, Olaussen, Maher: Syndepositional faulting in the Late Triassic succession of Kvalpynten, Edgeøya, East Svalbard. Congress of the Italian Geological Society.

Trias website at UiO: [mn.uio.no/triasnorth](http://mn.uio.no/triasnorth)

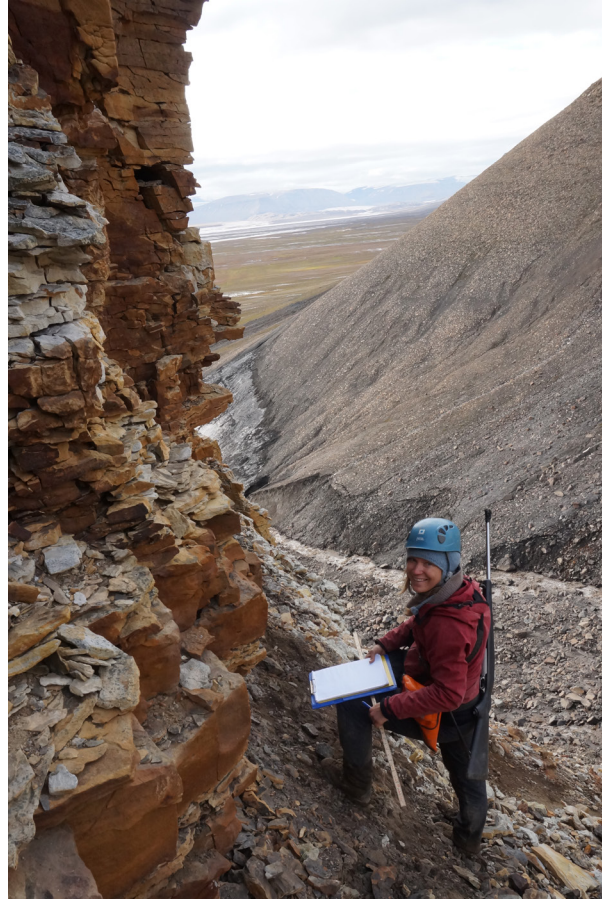
# Presenting our staff

We continue our presentation of people working at the Trias project. This time we take the trip to the far north to meet some folks at Svalbard.

## BERIT

My name is **Berit Husteli** and I am a PhD candidate in sedimentology at the University Centre in Svalbard. My research is revolving the sedimentology of heterogeneous coastal deposits affected by tides. I have a BSc in Construction Engineering from Oslo University College, a few years experience as an engineer and an MSc in Environment and Natural Resources from the Norwegian University of Life Sciences, specializing in Geology. Student summers were spent doing geological mapping for the Norwegian Geological Survey.

My PhD research deals with the Longyearbyen CO2Lab's targeted reservoir, the late Triassic De Geerdalen formation, and its sedimentology, depositional architecture and lateral facies distribution. The aim of the study is to describe tidally influenced sediments and their inherent heterogeneities in such detail that their characteristics can be parameterized and implemented into a reservoir model, successfully predicting fluid behaviour. The data will provide as specific input to on-going efforts to model reservoir properties of the Kapp Toscana Group. Additional foci are improved understanding of stacking patterns in tidal systems and the environments prevailing when the studied sediments were deposited.



## GARETH

My name is **Gareth Lord** and I am a PhD candidate at the Department of Geology and Mineral Resources Engineering at the Norwegian University of Science and Technology (NTNU) in Trondheim. I am also an external PhD at the University Centre in Svalbard (UNIS). My project work is funded by the Norwegian Petroleum Directorate (NPD) and will be conducted in close co-operation with the Triassic North Project, SINTEF and the University of Bergen.

I graduated the University of Plymouth in England in 2010, with a Bachelor Honours Degree in Geology, including a thesis which involved mapping the area of Harstad in northern Norway. My career in Svalbard began the same year as a field assistant with SINTEF, NPD and later for UiT, an opportunity which subsequently developed into a thesis. I earned my masters in Petroleum Geology at NTNU in Trondheim, in association with UNIS.

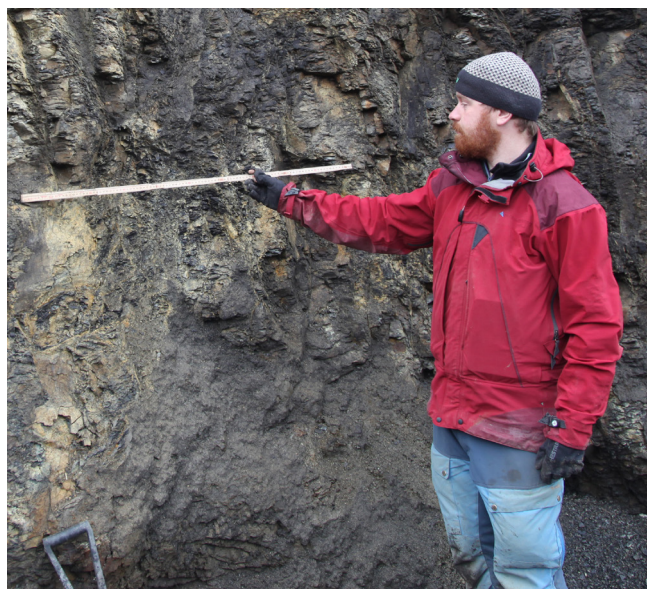
The topic covered a regional development of fracture patterns throughout central Spitsbergen, Edgeøya and Hopen.

My PhD project is to increase the understanding of the entire Triassic succession of Svalbard and the Northern Barents Sea. Implementing an extensive field dataset, with recent offshore data from eastern Svalbard and the Kong Karls Land region. The objective being to discern the more discrete sedimentological and stratigraphical developments within the succession.

# MARK

My name is **Mark Mulrooney**, Trias North PhD candidate at the University Centre in Svalbard (Unis), where my research is focused on Triassic basin development and evolution in the Barents Shelf. Prior to commencing my PhD research I obtained a BSc in Geology from University College Dublin, and an MSC in Petroleum Geoscience from Royal Holloway, University of London.

My research focusses on fault activity during the Triassic utilising 3D seismic surveys. In addition I am conducting outcrop and core based studies of tensile Tertiary structures affecting Late Triassic to Early Jurassic sediments in the Longyearbyen environs. I was responsible for acquiring Triassic outcrop photogrammetry during last summer's field work in Eastern Svalbard which is currently being rendered into a high resolution 3D model. The model will allow interpretation of regional characteristics of a deltaic system interacting with syn-depositional faulting. In addition we will deploy UAV mounted high definition cameras during next summer's field season in order to capture imagery from otherwise inaccessible areas.



# ALEKS

My name is **Aleksandra Smyrak-Sikora**. I am PhD student from the University of Bergen working in the University Centre in Svalbard. My PhD project focuses on the architecture of sediments deposited in areas of active tectonics. An excellent example of interaction of faulting with sedimentary processes can be found in Kvalpynten (Southern Edgeøya), where along of nine kilometres long cliff, twelve small scale sedimentary basins (grabens and half grabens) are exposed.

I have been attending expeditions to Edgeøya twice, in 2012 and 2014, where my main task was to study sedimentary fill of Kvalpynten grabens. Despite steep mountain slopes our Triassic North Group managed to log more than 1800 m of sandstones and shales deposited within fault-bounded basins and above them. Currently I am working on facies interpretation and sedimentary architecture of basins we managed to log to and I am trying to link the evolution of sediments and fault activity.

I came to Svalbard for the first time in 2006 to do fieldwork for my Master thesis, focusing on ductile deformation in Hecla Hoek Succession, exposed in SW Svalbard. In 2008 I defended MSc degree at the University of Wrocław, Poland. I work at UNIS since 2012. In addition to Triassic rocks on Edgeøya, I also study Carboniferous rift fill in Billefjorden, Central Spitsbergen.

**The Trias North project** is hosted by University of Oslo and funded by the Research Council of Norway, Tullow Oil, Statoil, Lundin Norway, Edison Oil and RWE Dea. Research partners are University of Bergen, University Centre in Svalbard, Norwegian University of Science and Technology, NORSAR, Uni Research, University of Utrecht, University of Parma, Polish Academy of Sciences, and University of Nebraska at Omaha, and we are cooperating with Geological Survey of Norway, Geological Survey of Canada and others.

Please spread this newsletter within your institution and to other Trias fans.