det dannes en vulkan? Geologi er et beskrivende fag, og det presenteres like mye gjennom illustrasjoner som via tekst. Dette vil jeg utnytte, og jeg har laget en rekke illustrasjoner som gjør innholdet lettere å forstå. Arbeidet er godt i gang og jeg forventer at boken lanseres i slutten av 2017.

Some characteristic geometrical aspects of large normal faults in multiphase rifts: a seismic case study from the Lofoten margin

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The evolution of normal faults during continental rifting represents a more or less continuous process starting with an inception stage, followed by interaction and linkage and finally a rift climax stage. In basins that are characterised by several distinct rift episodes, i.e. a multiphase rift, the process of inception, linkage and climax is repeated for each rift episode. A later rift episode may be characterised by the reactivation of buried older rift faults depending on (i) the extent to which the buried faults have healed since the previous rift phase; (ii) the extension direction with respect to the pre-existing rift fabric; and (iii) the thermal and rheological state of the lithosphere. We explore the geometrical differences between large normal faults that formed during a single rift episode and those that formed within the context of a multiphase rift system in which faults were reactivated between the different rift episodes.

The Lofoten margin evolved as a part of the North Atlantic rift system that was active for more than 200 Myr, from Palaeozoic to Cenozoic times, over several rift episodes separated by long (>20 Myr) inter-rift periods. Using an extensive dataset consisting of 2D and 3D seismic reflection surveys we mapped the main basin-bounding fault zones that characterize the Lofoten margin. These fault zones constitute several linked segments and are over 100 km long. They formed to different extent from the selective reactivation of an older Triassic set of faults that had been buried by c. 1-2 km of Lower Cretaceous strata before renewed extension took place in the middle Cretaceous. Two observations regarding the geometry of the Lofoten margin's structural style stand out:

1. Some of the Cretaceous through-going fault zones exhibit plan-view zigzag geometries, whereas others are more linear. We observe a correlation between the propensity of Cretaceous fault zones to develop zigzag geometries and the presence of a well-developed set of buried Triassic rift faults.
2. The through-going fault zones exhibit a curved geometry at the Cretaceous level, lacking the sharp corners that are observed at the links between the ancestral fault segments at the Triassic level.

We discuss to what extent these observations may be characteristic for the structural style of multiphase rifts, and compare our observations to the results of recent scaled analogue models. We conclude that i) large normal faults that formed in a multiphase rift are particularly prone to form zigzag geometries, being composed of segments that formed during different rift episodes and ii) the upward propagation of pre-existing, buried fault segments through a rheologically weak overburden likely promotes an upward change in failure mode from tensile to shear, giving the upper, youngest part of the fault a more curved plan-view geometry.

Linking lithosphere deformation and sedimentary basin formation over multiple scales

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Here we focus on the relationships between tectonic deformation and sedimentary basin formation. Resolving the interaction and feedback between tectonic crust-lithosphere scale deformation and surface processes through erosion of elevated areas and formation of sedimentary basins over multiple scales has been a long-standing challenge. While forward process based models have been successful at showing that a feedback is expected between tectonic deformation and redistribution of mass at the earth's surface by erosion, transport, and deposition, demonstrating this coupling for natural systems has been an even greater challenge and is strongly debated. Observational constraints on crust-lithosphere deformation and surface processes are typically collected at highly varying spatial and temporal scales, while forward process based models are typically run at either very large lithosphere-mantle scale, or at the scale of the sedimentary basin making it difficult to investigate and explore the detailed interaction and feedback between these systems. Here I will report on recent advances in forward modelling linking crust-lithosphere deformation with surface processes over a large range of scales resolving tectonic plate scale deformation and sedimentary basin formation at stratigraphic scales. The forward numerical models indicate a linkage and interaction between the structural style of thick-skinned large-scale mountain belt and rift-passive margin formation, erosion-transport-deposition processes operating at the surface, and the thin-skinned deformation occurring in the associated sedimentary basins.

Death and survival in the Early Triassic – Svalbard revisited

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Three fieldwork seasons in Flowerdalen, Spitsbergen, Svalbard (2014-16) and its vicinity have yielded an unforeseen amount of new vertebrate taxa from the Early Triassic Vikinghøgda Formation and Middle Triassic Botneheia Formation. So far the material has been studied in four Master theses.

In 2014 and 2015 the Botneheia Formation was collected and two main quarries were made. Several mixosaurid skeletons were excavated and one large cymbospondylid. In the uppermost Vikinghøgda Formation a bonebed with large ichthyopterygians was collected. The collection consists of more than 500 vertebrae, 400 limb elements and 250 skull and jaw elements.

A rich bonebed in the lower part of the Vikinghøgda Formation, most likely the *Grippia* layer of Wiman and Stensiö, was found in 2014, partly excavated in 2015 and was the main focus in 2016. A large excavation was made in this layer. In two weeks the team dug 70 metric tons of shale out of the quarry by hand to uncover the bonebed. The reward was 800 kilos of bones of sharks, lungfish, amphibians, and several enigmatic early marine reptiles. This is by far the biggest find in the World of the strange marine reptile *Omphalosaurus* (about 1000 vertebrae, numerous jaws, skull bones and limb bones). Another discovery was more than a thousand vertebra, limb bones and skull fragments all most likely attributed to *Grippia*. *Grippia* is a legendary early ichthyosaur seen by many as the primitive ancestor of all later ichthyosaurs. The material has so far been limited to a handful of concretions with partial skeletons housed in the Museum of Evolution in Uppsala.

The team also made a collection of associated vertebrates and invertebrates stratigraphically above and below the two bonebeds to provide paleoecological and stratigraphic context. In relation to this several sedimentological logs to document the stratigraphy and a collection of shale for carbon isotopes were made

Previous work on Triassic marine reptiles from Svalbard demonstrates that they are crucial in understanding the evolution of ichthyosaurs globally. However, no major field-based research programme has been conducted on Triassic reptiles in Svalbard for a century since the first important discoveries were made by the Swedes. This has now changed. While other fossiliferous Triassic sites are known around the World, these bonebeds are unique in its Early Triassic position (more than 247 million years old, still waiting for absolute dating) and will within a few years contribute largely to the understanding of the recovery of the marine ecology after the biggest extinction of them all – the Permian-Triassic extinction.

Evolutionary transitions: examples from the Ediacaran and Cambrian of the Digermulen Peninsula, Arctic Norway

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Fossils record evolutionary processes, biotic turnovers and major transitions in the Earth system history. Transitions may be abrupt or gradual, but their study depends often on the quality and extension of the material or sections available. The Digermulen Peninsula is one of few places in the world where a more or less continuous succession records the major biotic revolution and establishment of early animals during the Ediacaran and Cambrian transition 541 million years ago, as well as the diversification of the Cambrian ecosystems. Two case studies will highlight two transitions.

Following the major glaciations about 580 million years ago, before the Ediacaran – Cambrian transition (E–C), the first macroscopic organisms emerge. Prior to this, life consisted of mostly small, usually single celled organisms. The difference between microscopic and macroscopic life is fundamental and concerns basic issues like respiration, uptake of nutrients and reproduction. These first macroscopic organisms are collectively called ediacarans and their interpretations remain controversial. Some representatives may not have any modern counterparts, some are most likely related to cnidarians, but there are few candidates for bilaterian animals such as annelids and arthropods. The detailed record of trace fossils on the Digermulen Peninsula gives us the possibility to study the early evolution of bilaterians. Increased complexity of traces across the E–C transition reflects increasingly complex trace makers, requiring an internal body cavity and an anterior concentration of the nervous system. At the E–C boundary, appears *Treptichnus pedum*, consisting of complex branching burrows, and later the first traces made by animals with limbs, with the appearance of *Rusophycus*. On Digermulen *T. pedum* is found in the upper part of the Stáhpogiedde Formation with the first *Rusophycus* in the lower Breidvik Formation.

The backbone of Cambrian stratigraphy in Baltoscandia is a combined record of trilobites and organic walled microfossils (OWM). In the lower Cambrian, trilobites are rare, and their distribution is not always compatible with the microfossil record, thus hampering correlations. The transition to the traditional middle Cambrian in Baltoscandia is generally marked by the regional Hawke Bay unconformity and a shift from siltstone and sandstone deposits to mudstone deposits. It may be a result of a transient uplift of western Baltica, yielding a larger hiatus in the southern parts compared to the northern parts. On the Digermulen Peninsula this interval is straddled by the upper member of the Duolbagáisá Formation and the lower member of the Kistedalen Formation (K1). The former has been considered lower Cambrian and the latter middle Cambrian in age. The succession does not reveal obvious sedimentary breaks although the transition to the K1 is marked by the last thick quartzite unit in the Duolbagáisá Formation. Trilobites of the lower Cambrian *Holmia kjerulfi* Assemblage Zone are recorded about 180 m below the formation boundary, while typical middle Cambrian trilobites occur in the K1 member. Recent analyses of a more continuous record of OWMs allows a more precise correlation, identifying the *Heliosphaeridium dissimilare-Skagia ciliosa* Assemblage in association with the holmiid trilobites and the younger *Volkovia-Liepaina* Zone about 95 m below the boundary. The latter zone spans the traditional lower and middle Cambrian

ISBN: 978-82-8347-018-5

NGF Abstracts and Proceedings
NGF Abstracts nad Proceedings was first published in 2001.
The objective of this series is to generate a common publishing channel of all scientific meetings held in Norway with a geological content.

Editors:
Hans Arne Nakrem, UiO/NHM
Ann Mari Husås, NGF

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Norsk Geologisk Forening
c/o Norges Geologiske Undersøkelse
N-7491 Trondheim, Norway
E-mail: ngf@geologi.no
www.geologi.no

Published by:
Norsk Geologisk Forening
c/o Norges Geologiske Undersøkelse
N-7491 Trondheim, Norway
E-mail: ngf@geologi.no
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