Trap and seal analysis of the northern Barents Shelf

A study of cap rock integrity and top-seal characterization in the greater Hoop area

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/ INTRODUCTION

Although the majority of exploration wells in the Barents Sea has encountered hydrocarbons, only two fields, the Snøhvit (gas) and Goliat (oil) fields are currently in production. The geological evolution of the area, including previous deep burial and subsequent exhumation, has contributed to the leakage of HC from many traps. Understanding the timing of HC generation and migration, trap formation and regional cap rock properties, as well as the exhumation history of the area is crucial to succeed in reducing the exploration risk in the Barents Sea. The overall aim is to understand the geological risk factors that have influenced seal integrity in a spatial-temporal framework.

/ PLANS FOR THE PROJECT

- Analyse pressure, core- and geophysical log data.
- Interpret seismic data to aid in the establishment of a structural framework of the seleced cases and also to aid in the development of local- to regional-scale cap-rock distribution maps and stratigraphic models.
- Fieldwork and investigation of onshore analogues in Svalbard and/or Eastern Greenland. Additionally cores from the CO2-wells in Adventdalen will be investigated.

/ DISCOVERIES

- The greater Hoop area (Fig 1), shown in the red square, includes some of the northernmost production licenses on the NCS.
- In 2013, the Wisting field was discovered while drilling the exploration well 7324/8-1. The field was uncovered in the Hoop-Maud Basin.
- In 2014 well 7325/1-1 discovered gas in the Atlantis prospect on the western flank of the Hoop Fault Complex.
- Several dry wells have also been drilled in the area (e.g Apollo, 7324/2-1).

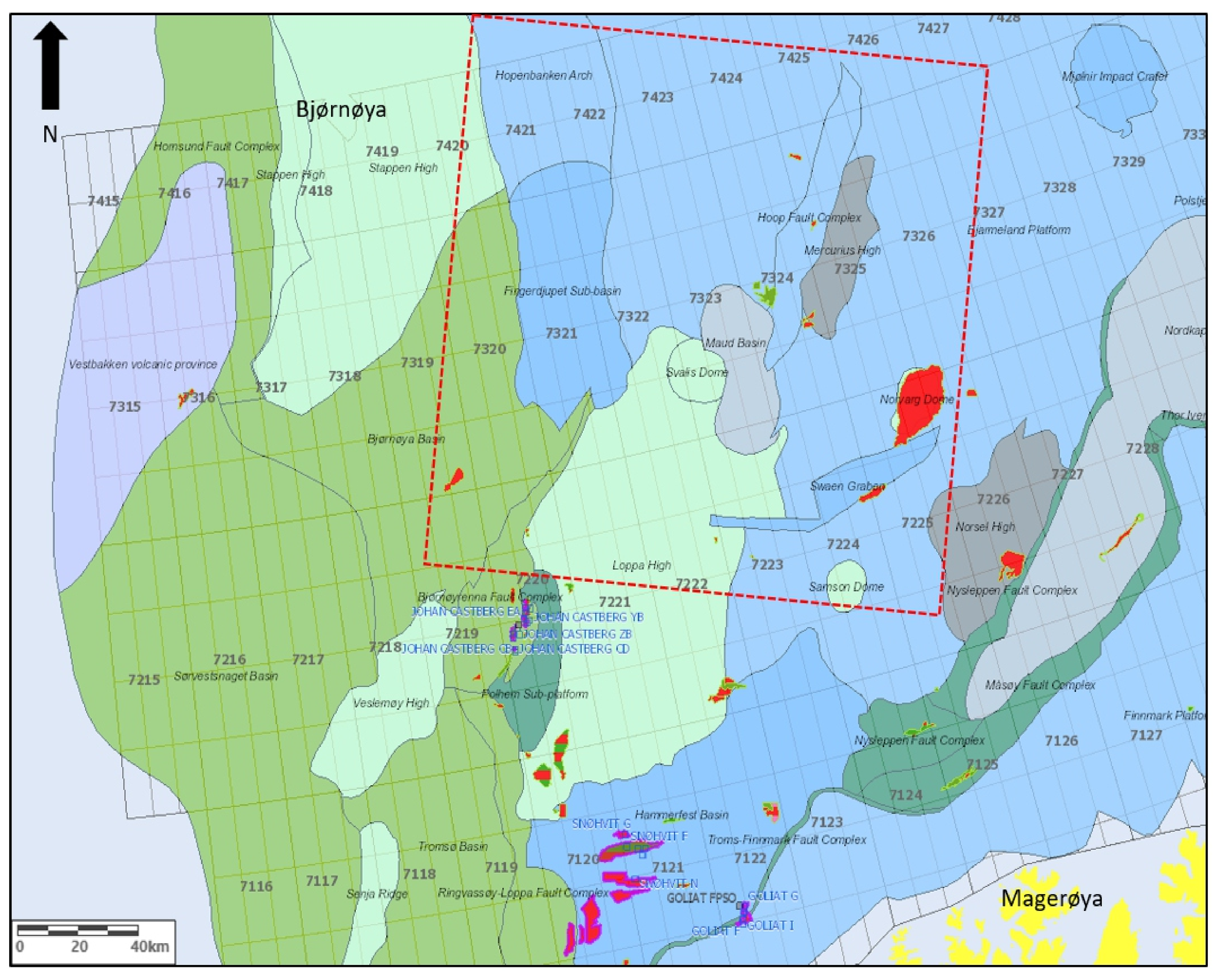

Fig 1(right) Overview of the Greater Hoop area and the main structural elements of the Greater Barents Sea including discoveries (http://gis.npd.no/factmaps/html_21/).

/ WHAT IS A CAPROCK/SEALING UNIT?

- An impermeable unit, commonly shale, salt or anhydrite that prevents any fluids from leaking through.

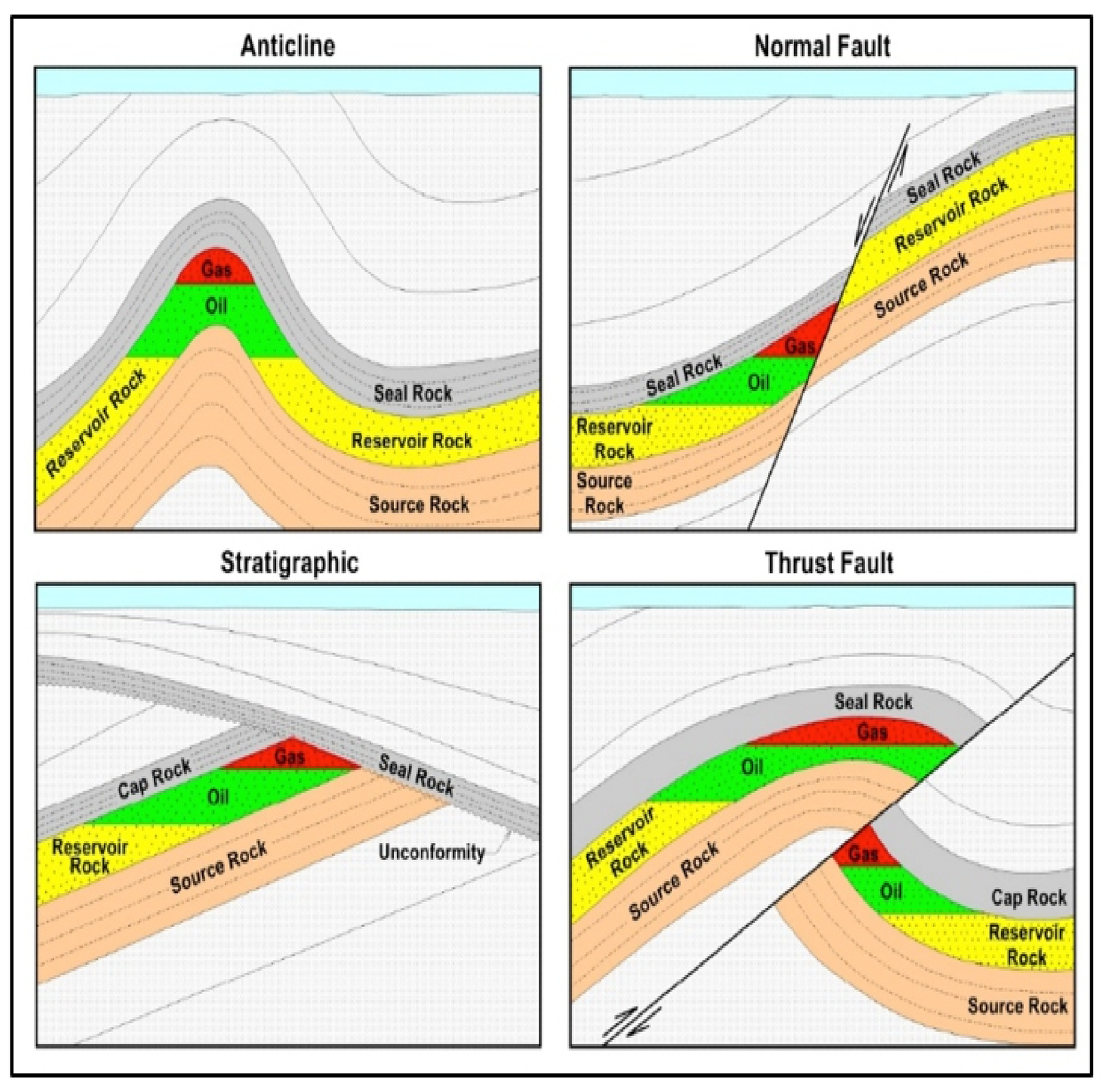

Fig 2 (right) Sketch showing how a sealing unit can hold hydrocarbons in place under different tectonic settings. (https://www.iris.edu).

/ UPLIFT, EROSION AND ITS IMPACT ON HYDROCARBON RESERVOIRS

Studies show that the Barents Sea area has undergone a considerable uplift, with as much as 3000 m in some areas (Nyland et al. (1992), Dimakis et al. 1998, Smelror et al. 2009). The exact mechanism behind this uplift is still under debate, but it is most likely combination of processes contributed, including the opening of the Norwegian-Greenland Sea (Faleide et al. 1984, Nyland et al. 1992, Dimakis et al. 1998). Knowledge of the uplift and erosional history plays an important role in prospectivity (Henriksen et al. 2011).

As sediment subside, they are influenced by the overburden load. The cap rock integrity is related to the amount of overburden and gravitational load. If the reservoir is uplifted, and the overburden removed, the caprock might lose its integrity, fracture and start leaking causing the hydrocarbons to leak through the no longer sealing unit, emptying the structure(Henriksen et al. 2011).

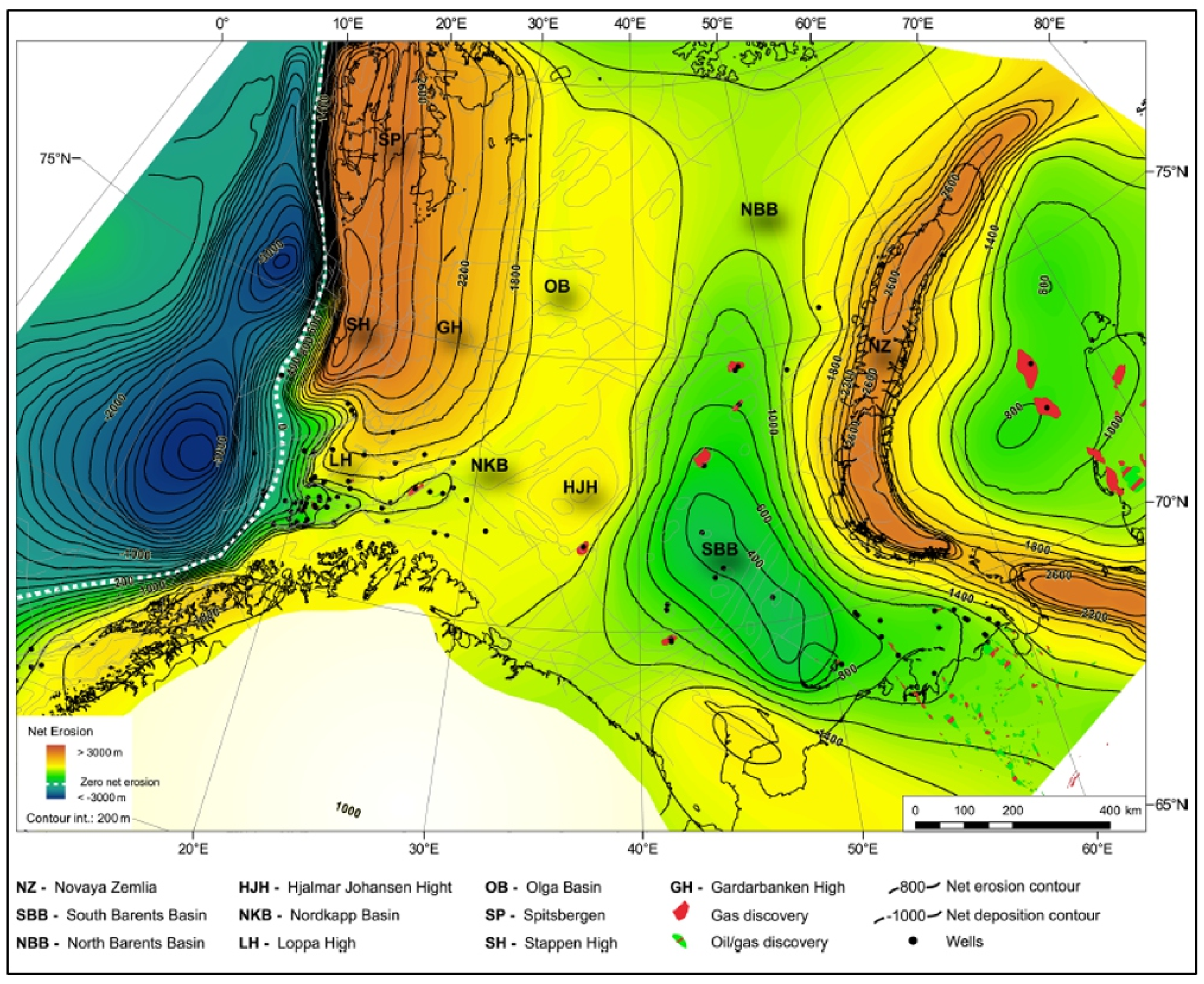

Fig 3 (left) Regional map illustrating the estimated net erosion for the Greater Barents Sea. On the western part there has been little to no erosion, only subsidence. Over the entire Barents Sea region, the estimated net erosion ranges from zero to >3000 m. Figure from Henriksen et al. (2011).

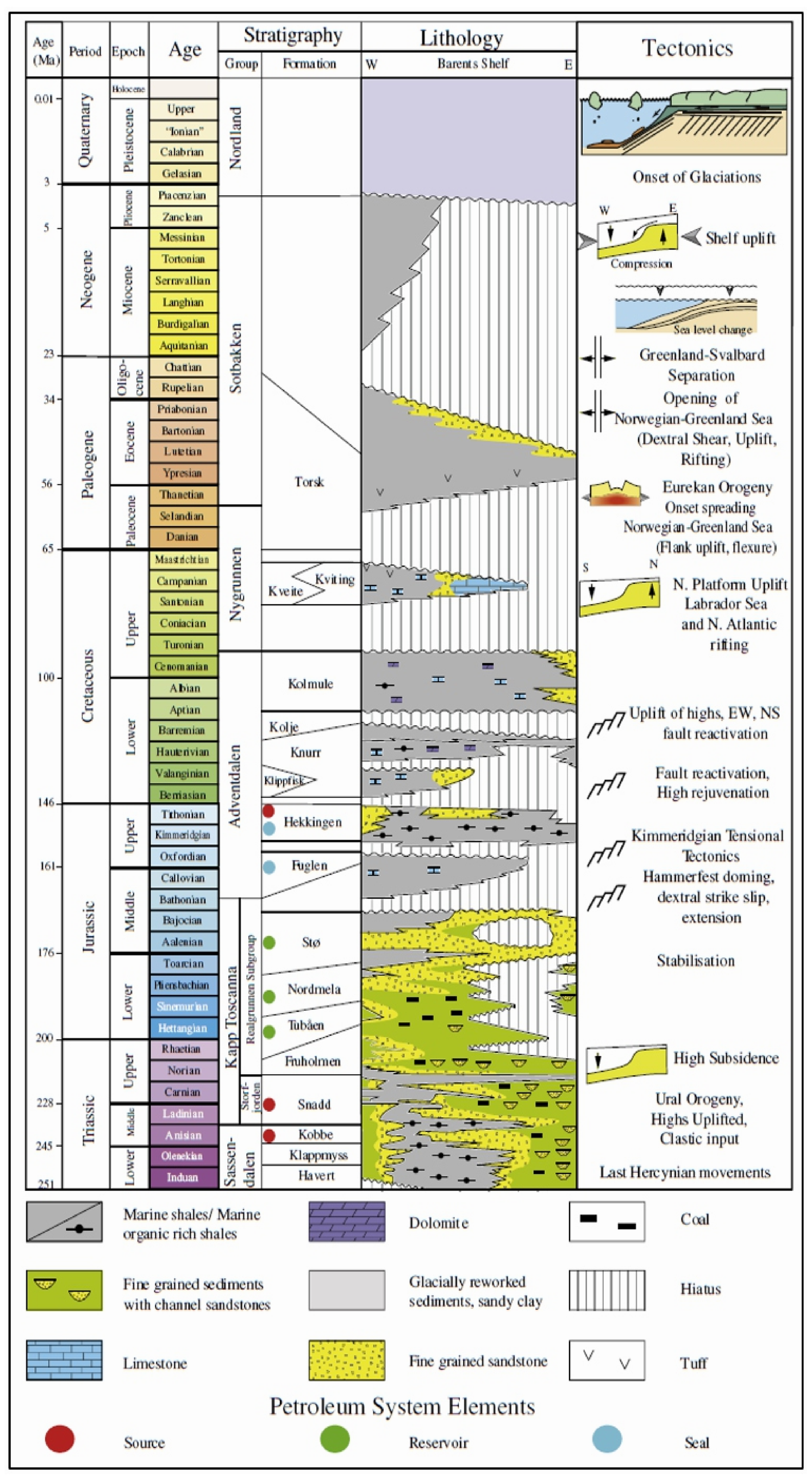

Fig 4 (right) Litostratigraphic chart showing both the major tectonic events and the following depositional environments. The different source, reservoir and cap rocks in the Barents Shelf area is indicated in their respective formations. Figure is modified after Ostanin et al. (2012).

- The Fuglen and Hekkingen formations, both Upper Jurassic constitute good cap rocks, with the latter also being a proved source rock.
- The Hekkingen Formation has been drilled in The Bjørnøya Basin (Fingerdjupet Sub-basin) and on the Bjarmeland Platform, and consists mainly of organic rich marine shales, with occasional thin interbeds of limestone, dolomitic siltstone and sandstone.
- The Fuglen Formation consists mainly of pyritic mudstones interbedded with thin limestone layers.
- Another important caprocks in the Barents Sea is the Kolmule Formation (Lower Cretaceous).

Source: http://factpages.npd.no

/ REFERENCES

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