Middle Miocene sandy deposits of the Nordland Group, northern North Sea

(Suggested called Eir Formation, extent and thickness, age from fossil and strontium isotope correlations, lithology, paleobathymetry and regional correlation)

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Middle Miocene sediments in the northern North Sea represent the basal part of the Nordland Group and occur as an infilling unit within the Viking Graben. South of the Viking Graben, these are mainly fine grained sediments. Middle Miocene units in the wells 15/9-13, 25/1-8 S, 25/2-10 S (southern Viking Graben) and 30/5-2 and 30/6-3 in the northern Viking Graben are sandy and microfossils indicate an inner to middle shelf environment. The age is to a large extent based on the occurrence of the index fossils B. badenensis and B. reticulata and Sr isotope analyses. The Middle Miocene section in well 25/1-8 S was probably deposited at a very shallow marine site and oceanic forms as Bolboforma did not enter the area. In this well the age is mainly based on correlation of benthic and planktonic foraminifera and a number of Sr-analyses. In the wells, it may be difficult to distinguish these sands from sands of Utsira above and Skade below. Seismic data indicate that in the mid Miocene, the delta front in the Frigg area prograded to the east. The sandy deposits in the 25/1-8 S well penetrated the delta clinoforms. A thick depocenter of Middle Miocene sands was developed east and north of the Frigg area in a more distal shelf environment (sands penetrated in 30/5-2 and 30/6-3, Fig. 8). The Middle Miocene sandy sections appear to form mappable units which are clearly younger than the Skade Formation and older than the Utsira Formation in the Viking Graben, and we tentatively introduce the name Eir Formation, after an Æsir in Norse mythology, for these units in the Norwegian sector as a new formation in the Nordland Group (Fig. 7). We suggest 25/2-10 S from 630 to 520 m (Fig. 2) as the well type section and 30/5-2 from 920 to 760 m as the well reference section (Fig. 10). In the same way as the Skade and Utsira, this unit also merges with parts of Hutton sand in the western part of block 25 (Profile 1). Well 25/1-8 S and 25/2-10 S are situated in the distal part of the Hutton sand area according to Gregersen & Johannessen (2007, Fig. 8). However, we suggest using the term Eir Formation for this unit in Norwegian waters.

Thickness of the Middle Miocene sandy deposits of the Nordland Group

(suggested called Eir Formation)

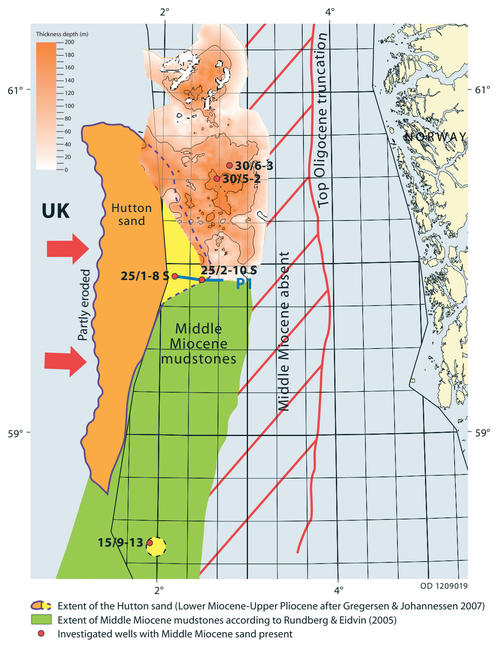
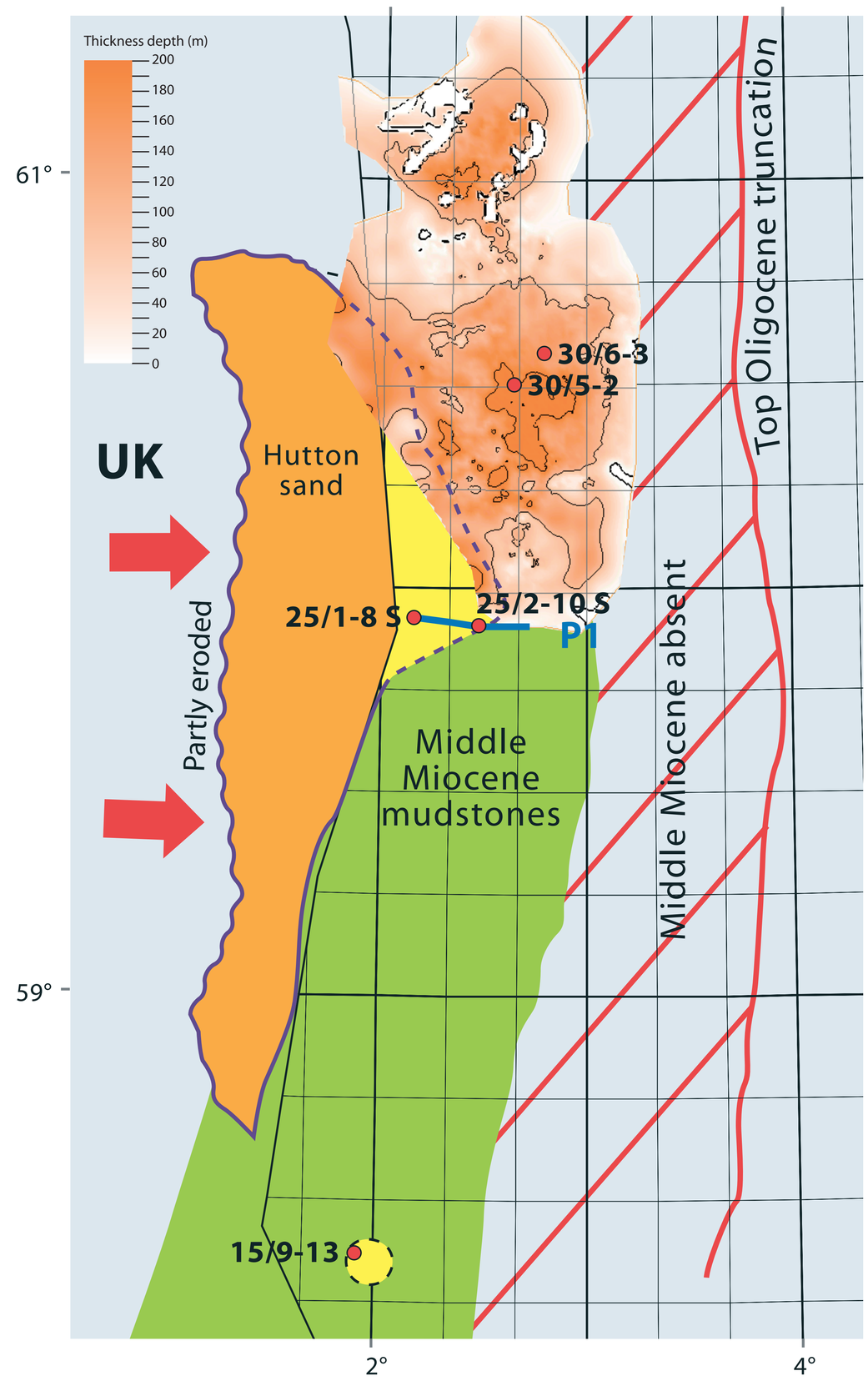
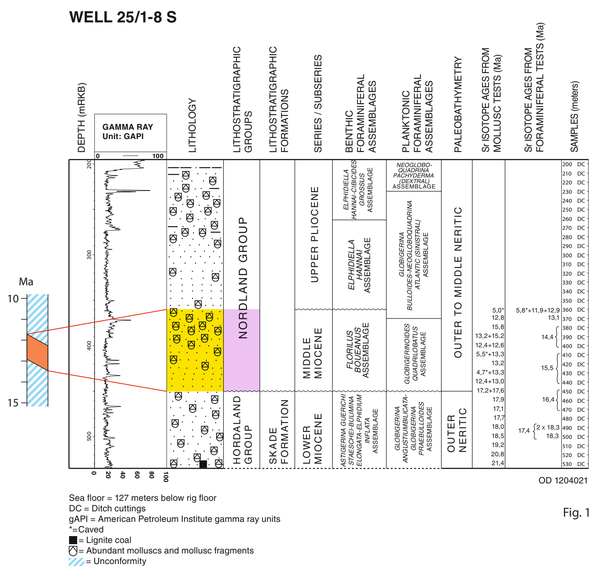


Fig. 8: Thicness of the Middle Miocene in the Northern North Sea consisting mainly of sandy deposits. The extent of the Hutton sand is according to Gregersen & Johannessen (2007), and the extent of the Middle Miocene mudstones is according to Rundberg & Eidvin (2005).

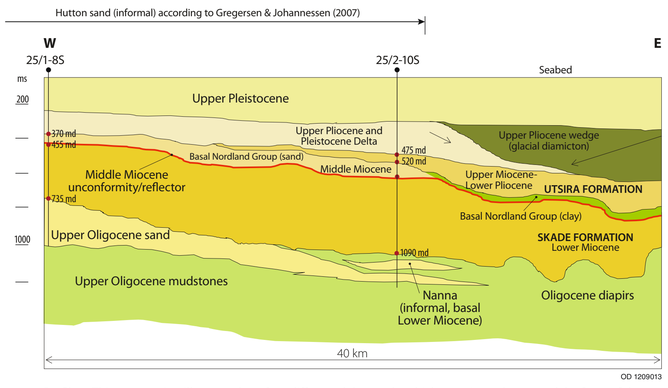


WELL 25/1-8 S



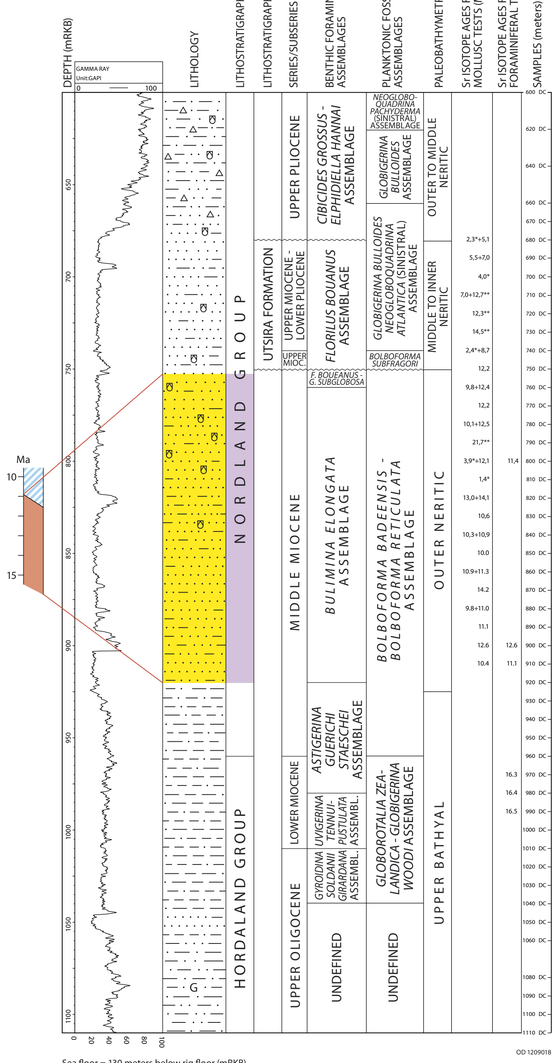
Sea floor = 127 meters below rig floor
DC = Ditch cuttings
gAPI = American Petroleum Institute gamma ray units
* = Caved
= Lignite coal
= Abundant molluscs and mollusc fragments
= Unconformity

Fig. 1



Profile 1: This geo-section illustrates how four different delta sands, which constitute the outer delta front of the Hutton sand system (informal name used only in UK waters) are deposited. In Norwegian waters the Lower Miocene Skade Formation is turbitic in origin and overlays Oligocene mudstones. The Utsira Formation overlays a mud prone, distal Middle Miocene unit and thins out west from the delta front towards the 25/1-8S area (overlaying sandy Middle Miocene deposits). An Upper Pliocene delta builds on top of the Utsira Formation in the 25/2-10S area, modified after Gjeldvik et al. (2011).

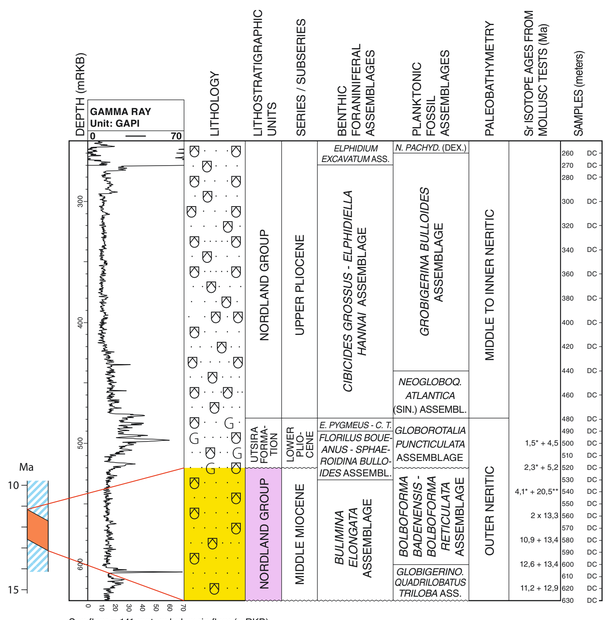
WELL 30/6-3



Sea floor = 130 meters below rig floor (mRKB)
DC = Ditch cuttings
GAPI = American Petroleum Institute gamma ray units
= Ice rafted pebbles
= Abundant molluscs and mollusc fragments
* = Caved
** = Reworked
= Unconformity

Fig. 9

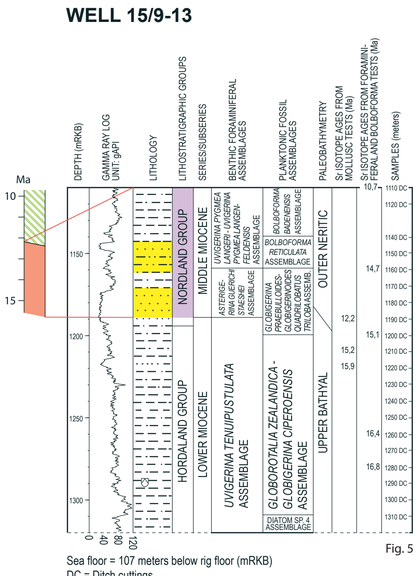
WELL 25/2-10 S



Sea floor = 141 meters below rig floor (mRKB)
DC = Ditch cuttings
gAPI = American Petroleum Institute gamma ray units
= Abundant glauconite
= Abundant molluscs and mollusc fragments
* = Caved
** = Reworked
= Unconformity

Fig. 2

WELL 15/9-13



Sea floor = 107 meters below rig floor (mRKB)
DC = Ditch cuttings
gAPI = American Petroleum Institute gamma ray units
= Abundant molluscs or mollusc fragments
= Not investigated

Fig. 5

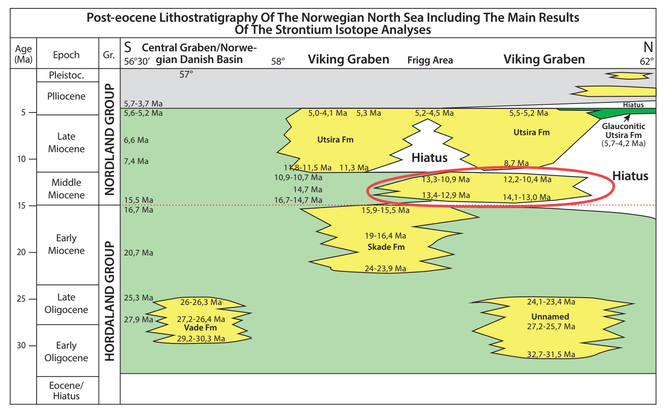


Fig. 6: Post Eocene lithostratigraphy of the Norwegian North Sea including main results of the strontium isotope analyses based on fossil tests interpreted to be in situ (after Eidvin et al., work in progress 2).

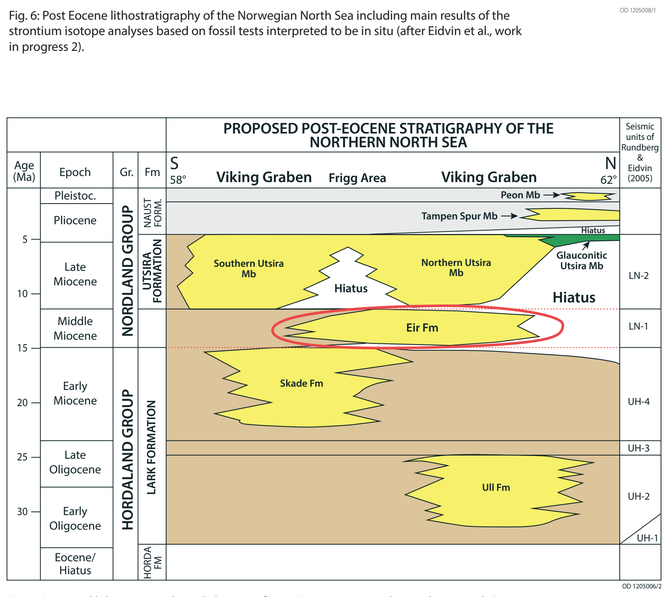
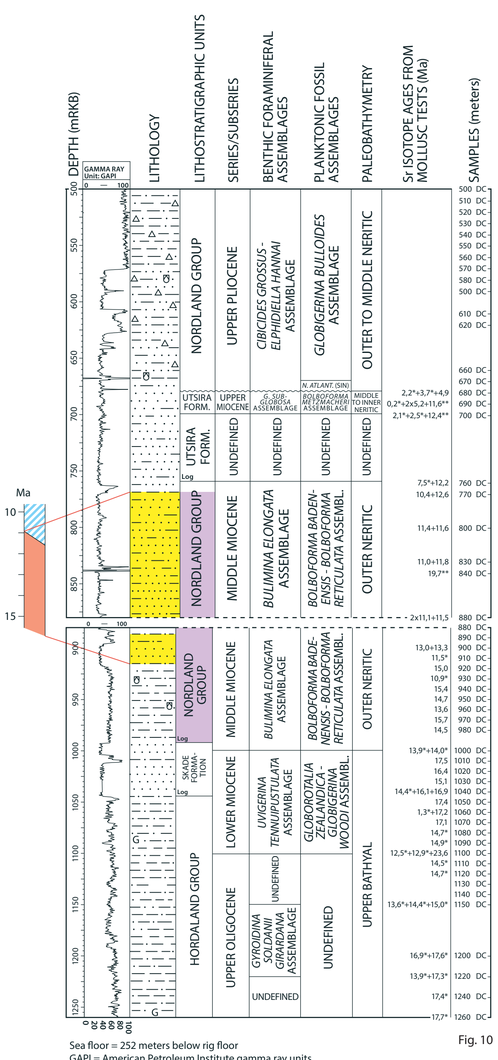


Fig. 7: Proposed lithostratigraphic subdivision of post-Eocene strata in the northern North Sea.
Mb = member, Gr = group, Fm = Formation.

WELL 30/5-2



Sea floor = 252 meters below rig floor
GAPI = American Petroleum Institute gamma ray units
DC = Ditch cuttings
G = Abundant glauconite
= Abundant molluscs and mollusc fragments
* = Caved
** = Reworked
= Unconformity

Fig. 10

Late Paleogene and Neogene lithostratgraphy

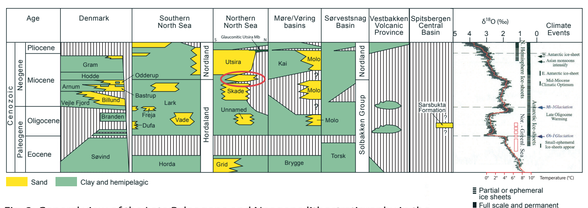


Fig. 3: General view of the Late Paleogene and Neogene lithostratigraphy in the investigated areas modified after Rasmussen et al. (2008) and Rundberg & Eidvin (2005). On the right hand side of the diagram there is added some paleoclimatic data including a global deep-sea oxygen curve, bottom-water paleo-temperatures in the world's oceans and periods with ice-sheets in the Antarctica and northern hemisphere (after Zachos et al. 2001). Periods with deposition of IRD at ODP Site 913 (off East Greenland) are also indicated (Eldrett et al. 2007).

Geochronology of studied wells, boreholes and outcrops

(Middle Miocene sandy deposits in dark red)

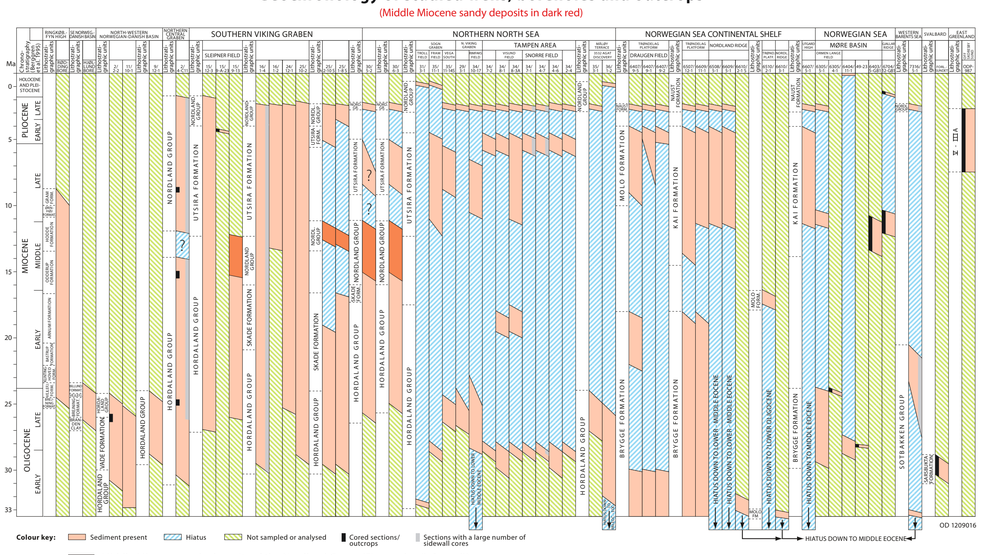


Fig. 4. Geochronology of all studied wells including the five wells with sandy Middle Miocene units in the northern North Sea (suggested called Eir Formation).

References:
If not stated otherwise all figures and text are according to:
Eidvin, T., Riis, F. & Rasmussen, E. S., work in progress. Oligocene to Lower Pliocene deposits of the Norwegian continental shelf, with correlation to the Norwegian Sea, Greenland, Svalbard, Denmark and their relation to the uplift of Fennoscandia.

Other references:
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