

Depositional architecture of the Neogene Skade and Utsira sands between 58° - 62° N, northern North Sea

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The Neogene Utsira and Skade formations of the northern North Sea have been challenging and difficult to understand since their first definitions in 1977 and 1989, respectively. Recently, Eidvin et al. (2022) presented a revised lithostratigraphic scheme for the Eocene to Pleistocene succession, including a new Utsira Group, addressing errors in the nomenclature. Our study presents new findings on the depositional architecture of these sand-prone lithologies. The study is based on integrated interpretation of regional 2D seismic data, wireline logs from exploration wells, and biostratigraphic and Sr isotopic dating of the Neogene strata in selected wells (Rundberg & Eidvin 2005; Eidvin & Rundberg 2007; Eidvin et al. 2013).

The Skade Formation (Aquitanian-Burdigalian, 23.0-16.0 Ma) represent a sandy system shed from the East Shetland Platform (ESP) comprising shallow marine prograding facies in UK and parts of Central Viking Graben, Frigg Field area (CVG), slope and channel sand facies fringing the prograding shelf margin, and thick strata of basin-floor gravity sands that accumulated in Viking Graben and adjacent areas between 58°30' - 61° N. The outline and pinchout of the sands suggest that deepest marine setting occurred in the Southern Viking Graben (SVG) and Utsira High (UH).

During Langhian-Serravallian (16.0-11.6 Ma), sand deposition was mainly directed towards the Northern Viking Graben (NVG), whereas fine-grained sediments accumulated in SVG and UH. In NVG, three distinct sandy units of the Utsira Group (U1-U3) were deposited during these stages, each with thickness exceeding 100 m. These units are illustrated along a SW-NE oriented transect from the ESP margin near the Frigg Field towards the Gjøa Field. The two lowermost units are bounded by distinct mudstone layers (5-10 m thick) that become truncated towards the shelf margin. The depocenters of units U2 and U3 switch laterally to the west and east of U1. U1 and U2 are inferred to represent Langhian T/R-sequences where much of the transgressive shallow strata are eroded. U1 forms the basal part of the Utsira Group and also the top of the Hordaland Group.

During Tortonian – Messinian (11.6 – 5.3 Ma), sandy deposition resumed in SVG and UH where thick (+100 m) Utsira sands (B1) with thin interbeds of mudstones accumulated. Simultaneously, sand deposition also took place in NVG and Tampen Spur areas, where Utsira sands (U4, U5) attain thickness exceeding 100 m. Input from the Norwegian mainland also occurred during these stages.

In SVG and UH, Utsira sand (B1) deposition continued during Zanclean (5.3 -3.6 Ma). Along the SVG, these piled up on the upper Miocene B1 sands to a combined thickness of about 200 - 300 m. Eastwards on the UH, the B1 sands pinch out and overlie inclined lower Miocene strata. The B1 sands were sourced from the ESP via a wedge unit (B2) with distinct coarsening-upward GR log profiles in wells. The B1 sands are interpreted as gravity sands, laid down by turbidity currents which contrasts to the shallow sand bar model of Galloway (2002).

References

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