
Miocene sequence stratigraphy of the northeastern North Sea Basin: An eustatic fairytale interrupted by tectonism

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Abstract

Here we present a detailed study of a mixed siliciclastic and bioclastic (diatomite) depositional system from the epicontinental North Sea Basin. The study area encompasses an almost complete Miocene succession and is thus excellent in order to understand the geological evolution during this Epoch.

The eastern North Sea Basin was during the warm and humid Miocene dominated by a fluvio-deltaic depositional setting. A constant and high supply of sediment from the Fennoscandian Shield resulted in a continuous stratigraphic record. Outcrop-samples, cores and cuttings samples from onshore and offshore wells have provided material for a robust biostratigraphic framework for the succession. Based on this framework, a sequence stratigraphic subdivision has been established and seven sequences have been defined. In general, the sequence development was strongly controlled by eustatic sea-level changes as indicated by the asymmetry of all sequences, i.e., thin transgressive systems tract and relative thick high- and lowstand systems tract. Three of the sequences also comprise falling stage systems tracts. However, two tectonic events strongly influenced the depositional history; 1) late Oligocene – early Miocene inversion tectonism resulted in shallower water in the Norwegian-Danish Basin and thus progradation of the fluvio-deltaic system south of the Fennoscandian Shield, 2) Increased subsidence of the entire basin during the late middle Miocene resulted in flooding of the delta systems despite a concurrent global sea-level fall associated with the Middle Miocene Climatic Transition (MMCT).

The detailed bio- and sequence stratigraphy and the high density and quality of data (outcrops, boreholes and seismic) allow a detailed reconstruction of the paleo-landscape and paleo-bathymetry during the early to middle Miocene. The eastern portion of the North Sea Basin was dominated by wave-dominated deltas. In the deeper parts of the basin, mud was transported westward by submarine currents and plastered along the slope. In the central parts of the basin, biogenic ooze (especially diatoms and sponge spicules) formed a significant part of the detrital sediment particles, especially during the Middle Miocene Climatic Optimum (MMCO). The subsidence during the late middle Miocene resulted in a distinct change in deposition and formation/deposition of glaucony-rich clay basin wide. During the late Miocene resumed delta progradation from the Fennoscandian shield occurred. Associated with the Messinian sea-level fall, gravity flow deposits were laid down for the first time in the study area.

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