



Rapid Quaternary subsidence in the northwestern German North Sea

Jashar Arfai, Dieter Franke, Rüdiger Lutz, Lutz Reinhardt, and Christoph Gaedicke

Federal Institute for Geosciences and Natural Resources (BGR), Stilleweg 2, 30655 Hannover, Germany, jashar.arfai@bgr.de

The uppermost seismic units in the North Sea covering the Entenschnabel area, NW offshore Germany, have been studied systematically based on industrial multichannel 2D and 3D seismic data sets. As a result of these investigations, depth and thickness maps have been derived which are used in combination with well data for quantitative subsidence analyses.

Eight inter-Quaternary reflection surfaces are analysed showing distinct iceberg scour marks. They have been formed under shallow marine conditions in water depths less than 100 m and are used as chronostratigraphic markers. The base-Quaternary surface is found at depths, locally exceeding 1000 m, indicating a subsidence rate as high as 470 m/Ma and a more than tenfold increase compared to average Cenozoic sedimentation rates. The main Quaternary depocentre exhibits a NNW-SSE orientation, which partly overlaps the rift-related, Jurassic North Sea Central Graben. However, subsidence is not controlled by tectonic induced faulting during the Quaternary. Previously, a number of mechanisms and models have been proposed to explain this rapid Quaternary subsidence. From calculating compaction and load-induced subsidence we explain already about 80% of the observed Quaternary's deepening. However, the remaining ~20 % of subsidence needs additional processes to be invoked. The extensive seismic dataset interpreted here, allows to exclude a phase of renewed tectonic activity as origin for the subsidence anomaly. From the orientation and extend of the depocentre, lithosphere buckling and subsidence due to salt movement are considered as unlikely.

Mechanisms that may contribute to subsidence are local lower crustal flow or dynamic topography caused by mantle flow. However it remains unclear if there is a single origin or a combination of different processes to explain the ca. 20 % of residual subsidence.