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Salt-decoupled deformation during basin inversion in the Mesozoic Central Graben, Danish North Sea

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Complex basin-inversion structures resulting from thick- and/or thin-skinned tectonic shortening, provide important hydrocarbon plays in the Danish Central Graben. In spite of many years of research in the area, the kinematics of these structures have yet to be fully explained.
The Central Graben is part of the failed Mesozoic rift system in the epicontinental North Sea basin. Extensional tectonic phases in Late-Paleozoic to Late-Jurassic times were followed by primarily Late-Cretaceous lateral tectonic shortening and basin inversion.
Our integrated structural- and seismic-stratigraphic analysis of the Central part of the Danish Central Graben is based on horizon-, fault- and attribute mapping from a depth-converted 3D-seismic data set constrained by well data. We conclude from our results that salt tectonics associated to the western pinch-out areas of the Permian Zechstein Salt, may have played a so-far unappreciated role in the formation of some major structures in the study area. These elongated anticlinal structures formed during the basin inversion phases in Cretaceous times, and are bordered on one side by large reverse faults. We observe that these faults detach in the Zechstein Salt along the basement surface, i.e. decoupling deformation in sedimentary cover and basement (in line with thin-skinned shortening). This is in contrast to the simpler concept of reverse-reactivation of deep basement normal faults during basin inversion (thick-skinned shortening). It thus follows that the structural configuration of the area is the result of a complex interplay between basement, salt, and sedimentary cover during different tectonic regimes.
Our improved tectonostratigraphic model will provide a tool for the prediction of sub-seismic fault- and fracture zones in basins affected by compressional tectonics. The enhanced permeability of such zones allow for the commercial production of hydrocarbons from the Lower Cretaceous play in the Danish sector of the North Sea.