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Gravity gliding in the Bay of Mecklenburg? – New seismic data at the North German Basin margin

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Halotectonic pulses in the Bays of Mecklenburg and Kiel including the Glückstadt Graben have been previously explained by reactive and passive diapirism or differential load, e.g., caused by sub-salt faulting. Salt walls that formed above those sub-salt faults further grew during phases of inversion. Consequently, phases of enhanced halotectonics have been mainly related to the Triassic W-E extension, Jurassic North Sea doming, the Alpine orogeny. The location of salt walls was attributed to deep rooted sub-salt faults.
Alternative concepts of salt tectonics have been developed for continental slopes. Salt deformation may start already during the precipitation of the salt due to basin floor tilt, which may result from thermo-tectonic subsidence or from the salt load. As the consequence the emerging salt layer creeps towards the basin center causing internal folding and thrusting ("gravity gliding"). The resulting thickness variations of the salt are considered to be significant enough that sedimentation in the depressions directly initiate differential load and passive diapirism. Extensional faulting in the basin margin and diapirism in the central basin continues if basin subsidence continues or if basin margin sedimentation causes differential load on the salt rim ("gravity spreading").
In the course of RV MARIA S. MERIAN expedition MSM52 (BalTec) in March 2016 we imaged the tectonic conditions within the Paleozoic to recent sedimentary strata of the southern Baltic Sea between the North German Basin across the Tornquist Fan with yet unparalleled vertical resolution. The equipment consisted of 8 GI-Guns (70 Hz dominant frequency) as a source array and a digital seismic streamer of 2700 m active length. Due to the short initial offset of 37 meters between the seismic source array and the first active streamer section the data image without gap the subsurface geology from the Paleozoic strata or basement up to the seafloor.
A SW-NE striking seismic profiles from the central Mecklenburg Bay to the Skurup Block covers the northeastern North German Basin and its marginal setting where several fault systems are present. The Agricola fault system is a set of arcuate faults in the Post-Permian strata which emerged above along the pinch-out line of the mobile salt. Faults reach partly up to the seafloor suggesting recent displacement. Fault planes dip mainly towards the basin. These faults can well be understood as the consequence of salt gliding towards the basin center, hence, as the consequence of gravity gliding. The Werre and Prerow fault systems evolved above a salt anticline on top of the Grimmen High. A first major halotectonic pulse is suggested for the upper Triassic which led to salt depletion and enhanced deposition. During the Cretaceous inversion of the Grimmen High, a salt pillow emerged between both fault systems when the salt moved towards northeast and southwest. The absence of significant fault displacements beneath the salt pillows in the Mecklenburg bay is further consistent with the gravity gliding concept which explains salt pillow growth by thin-skinned shortening.