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Salt distribution in the Norwegian-Danish Basin, Central North Sea

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Salt tectonics have extensively been studied in most parts of the Central North Sea. However, few studies have been done in the Norwegian side of the Norwegian-Danish Basin. In this contribution, we report a new regional analysis of the salt patterns across the offshore Norwegian-Danish Basin.

We have mapped the regional distribution of salt structures in the Norwegian-Danish Basin using both old and recent 2D seismic reflection profiles tied to wells. The salt-thickness map shows three distinct salt structures patterns: (1) NW-SE trending salt walls in the northern part of the basin; the spacing between the walls vary between 7 to 12 km; (2) a dense and irregular distribution of salt diapirs in the southern part of the studied area; (3) an irregular pattern of sparse but big salt diapirs in the eastern part of the basin. This domain is characterized by numerous turtle structures associated with salt diapirs. Reflection seismic cross-sections show that most salt structures only pierce the Triassic sedimentary strata whereas only few salt structures reach the seabed. Rotated fault blocks indicate a gliding vergence towards the South in the eastern part of the basin and towards the SE in the western side of the Norwegian-Danish Basin. No mature or compressive salt structures, except some squeezed salt diapirs, are observed in the topographic lows of the basin. The initiation of salt tectonics started during the early Middle Triassic in the entire basin; salt tectonics reactivations were recorded during the Middle Jurassic, Paleogene, and prior to the Quaternary but are not homogeneous across the basin. Salt movements inferred from our study are in good agreement with previous studies.

The trend of salt walls (domain 1) indicates a NE-SW extension which is not compatible with N-S trending pre-salt faults. Instead, the strong Triassic subsidence towards the SW has most likely controlled the formation of the salt walls. The salt was initially thicker in domain 2 that also corresponds to the main depocenter of the first Triassic sequence. We suggest that both the salt thickness and the sedimentary differential loading, combined with the subsidence of the basin, have influenced the change of the salt pattern in domain 2. In domain 3, the reactivation of pre-salt faults might have triggered some of the salt structures. This area also received a large amount of sediments from the Skagerrak area during the Triassic subsidence, which may have influenced the distribution and evolution of salt diapirs and turtle structures. The combination of the different triggering processes and the different basin geometry of domain 3, which is bounded by highs to the South and North, in comparison to domain 2 which is open towards the Central Graben, are probably the key parameters that have controlled the salt pattern in this area. Finally, salt tectonics reactivations were likely controlled by the distribution of younger sediments and the successive tectonic regimes.