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# Diagenesis and organic-inorganic interactions of HPHT-reservoirs in the Central Graben of the North Sea

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High pressure-high temperature (HPHT) reservoirs at 3-5 km depth in the Jade and Judy fields (UK) are typical features of the North Sea Central Graben. We focused on a detailed description of petrography and quantitative analysis of mineral compositions to decipher the diagenetic evolution of the clastic sediments from the Triassic Skagerrak Formation from the Jade and the Judy fields in the UK sector of the North Sea within the framework of modeled burial and temperature histories of the study area. We recognized that the distribution and evolution of early diagenetic phases were predominantly determined by depositional facies. The diagenetic evolution of sandstones was strongly affected by interactions with interbedded mudstones and aggressive fluids enriched with organic maturation products, causing the dissolution of carbonates and feldspar. The best reservoir properties appear to be confined to high porosity zones in the central sections of sand-intervals where additional porosity probably was created by mineral dissolution. We found evidence that the reaction products caused the precipitation of ankerite or were consumed by mineral reactions in the surrounding mudrocks. Geochemical modeling was used to construct stability diagrams for the studied systems, evaluate viability of chemical reactions and for mass balance calculations of the studied system. In addition, it was used to derive initial fluid compositions for reactive-transport modeling which was applied to study the interaction between sandstones and mudstones. The limited amount of available thermodynamic data for modeling clay alteration only permits to model simplified clay mineral compositions. However, modeling results indicate that alteration of smectite to chlorite only occurs if

reduced iron is present as reaction partner in the system and the most likely source of iron is hematite reduced by methane. We modeled the alteration of smectites (Beidelite and Saponite) to chlorite (Ripidolite) successfully using this approach. The availability of iron will also control the formation of the observed ankerite cement. The results of reactive-transport modeling indicate an influence of organic maturation products formed during thermal maturation on the dissolution of K-feldspar and carbonate cement. However, with respect to K-Feldspar dissolution and albite precipitation, the high salinity and temperature increasing due to burial are the dominant parameters controlling this process. Reactive transport modeling also supports the assumption that diffusive transport of silica derived from clay mineral alteration in the mudstones caused quartz cementation of the sandstones. No direct evidence was found for an influence of overpressure on diagenetic evolution of the reservoir rocks. The complex mineralogy of the Triassic sandstones considerably complicates the modeling of water rock interactions. Still modeling results indicate that organic matter maturation products can significantly influence the diagenetic evolution of the studied reservoir rocks.