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Diagenetic fabric buildup and conservation in evaporitic Rotliegend successions from stratiformal and diapiric settings in the North German Basin

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The occurrence of rock salt from the Upper Rotliegend in the South Permian Basin marks the onset of halite deposition that persists throughout late Permian and Triassic times. Evaporation occurred in a precursor of the later Zechstein basin with a strong influence from siliciclastic deposition, which led to the formation of mixed evaporitic and siliciclastic rocks. This study covers petrographic and geochemical investigations of the fabric in halite successions as well as in mixed carbonate/siliciclastic layers of Upper Rotliegend age that are present in both stratiformal as well as in diapiric settings. The aim is to highlight common features that provide implications for fabric and facies genesis in evaporites. Samples were taken from a drill core of a salt wall located in the Glückstadt Graben and from > 4 km deep boreholes in Rotliegend sediments from the Northeast German Basin.

Halite successions contain variable amounts of siliciclastic material and minor carbonate and anhydrite. Carbonate layers often show lamination with variable contents of siliciclastic material, anhydrite and minor amounts of halite. Soft sediment deformation can be observed locally. The formation of diagenetic minerals includes anhydrite, euhedral dolomite crystals, quartz, chalcedony, laths of iron oxide as well as the occurrence of pseudomorphs of halite after gypsum/selenite. Mineral formation is restricted to material interfaces of e.g. siliciclastics and halite. The distribution and fabric of authigenic dolomite suggests its formation in a phreatic environment.

Anhydrite is present as nodules in detrital material or layers of microcrystalline anhydrite as well as euhedral/subhedral crystals. Sulphur as well as oxygen stable isotope values measured from sulphate ranges between 7,3 and 11,9 ‰ (δ34S) and from 14,5 to 18,4 ‰ (δ18O). High sulphur stable isotope values between 10,5 ‰ and 11,9 ‰ are restricted to sulphate from halite layers in both stratiformal and diapiric successions. Halite from both diapiric as well as stratiformal rock salt is characterized by concentrations of bromide between 2 and 10 μg/g halite, which excludes Permian sea water as the source for halite formation.

The stable isotopic composition of sulphate records changing environmental conditions with the formation of gypsum/anhydrite. Variations could reflect variable contributions of continental groundwater during mineral formation. Despite different paleogeographical and tectonic settings, the studied sequences can be correlated with regard to geochemical tracers as well as in respect to the nucleation of diagenetic minerals. Diagenetic fabrics are preserved in the evaporitic successions, which could be promoted by several cycles of evaporite formation and dissolution during early diagenesis.