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Geochemical side effects of potential Managed Aquifer Recharge into dune sands: The role of sediment characteristics and infiltrating water quality

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Global fresh water is one of the most affected resources under the aspect of changing climate. To mitigate groundwater overexploitation and improving its quality, Managed Aquifer Recharge (MAR) with desalinated water is of increasing importance. As a new approach for water desalination, the aim of the cooperative project “innovatION” is the development of a monovalent-selective membrane capacitive deionization method to improve the ecological footprint and to deliver a purposeful removal of ions. Nonetheless, the infiltration of a water with different water chemistry than natural pore- or groundwater causes geochemical interactions between water and sediment. As they might vary in their form and intensity depending on sediment characteristics the assessment for each potential MAR site is essential.

Here, we present first insights of geochemical water-sediment interactions during infiltration of a monovalent partial desalinated water (mPDW) into three different dune sediments from the barrier island Langeoog, Northern Germany, by conducted column experiments. Characterization of the sands from the beach, grey and brown dune indicates pedogenic development with increasing distance from the beach. The results of the column experiments show that ongoing processes such as cation exchange and calcite dissolution depend clearly on the sediment characteristics. The more pedogenically developed the infiltrating media is, the more complex the geochemical interactions get due to increasing fine fractions, organic and microbial components. Grey dune sands appear to be a suitable location for a potential MAR application on Langeoog due to less distinct geochemical reactions. Besides, the smaller chemical difference between recharge and natural water, the less intense the geochemical interactions. Trace elements, as for example As and V, were found in all sand types and their mobilization during infiltration seems to be linked to colloidal transport. The results showed that it not just depends on shifting redox conditions but also on the chemical composition of the infiltrating water, as As and V mobilization was periodically retained with mPDW. Nevertheless, all reactions are shown to be time limited during the experiments and unlikely to cause major problems but still better understanding of forcing mechanisms on a smaller scale is needed.