Water-sediment interactions during infiltration of partly desalinated water into different dune sediments

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Water scarcity is one of the world's most important problems. Notably, groundwater salinization due to saltwater intrusion at coastal regions or nitrate and sulphate input by fertilizers demand adapted desalinization techniques to secure the fresh water supplies. Water desalinization processes are therefore of increasing importance. However, groundwater recharge using desalinated water was shown to cause severe problems, like carbonate dissolution, clay mobilization up to leaching of harmful substances because of its low total dissolved solids (TDS) concentration. To overcome those problems may be an infiltration water that is not fully but only partly desalinated. Partly desalinated water (PDW) as a product of monovalent Membrane Capacity Deionization (mMCD) will be developed by the cooperative project "innovatION". With this technique up to 90 % of monovalent ions are removed.

Groundwater types from northern part of the East Frisian Island Langeoog are dominated by the calcium magnesium bicarbonate type but some can be grouped to the sodium chloride type where one of the measuring points is already saline with a TDS > 5 g/l. The trend of increasing groundwater salinization of the island Langeoog proposes it as a suitable location for surface infiltration to recharge the fresh groundwater. The geochemical interactions of PDW (TDS ~ 0.8 g/l, based on Langeoog groundwater chemistry) with ambient sediment were investigated by means of column experiments comparing dune sediments of different site locations. For this purpose, the respective dune sediment was initially equilibrated with saline groundwater and subsequently flushed with PDW.

First results with white dune material show cation exchange processes between Concentrations of major cations K^+, Ca^{2+} and Mg^{2+} in the column effluents decreased below concentrations in the inflowing PDW indicating adsorption/retention at soil surfaces also interfered by increasing HCO_3^- concentration. Subsequent rise of Ca^{2+} concentration higher than the initial concentration is a sign for carbonate dissolution. NO_3^- leaching occurred independently of the water salinity but more constant with infiltration of the PDW.

Summarized, dissolution and exchange processes take place due to the infiltration of PDW. Further experimental phases will be conducted with material from grey and brown dunes and also with fresh water equilibrated material in order to estimate the relevance of site characteristics. Geochemical reactions will later be visualized using PHREEQC simulations based on the experimental data. In conclusion, predictions about geochemical interactions during (surface) infiltration of PDW will help to find a suitable location for possible managed aquifer recharge.