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Numerical simulations of groundwater flow at New Jersey Shallow Shelf

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During IODP Expedition 313, three boreholes were drilled in the so-called New Jersey transect. Hydrochemical studies revealed the groundwater situation as more complex than expected, characterized by several sharp boundaries between fresh and saline groundwater. Two conflicting hypotheses regarding the nature of these freshwater reservoirs are currently debated. One hypothesis is that these reservoirs are connected with onshore aquifers and continuously recharged by seaward-flowing groundwater. The second hypothesis is that fresh groundwater was emplaced during the last glacial period.

In addition to the petrophysical properties measured during IODP 313 expedition, Nuclear Magnetic Resonance (NMR) measurements were performed on samples from boreholes M0027, M0028 and M0029 in order to deduce porosities and permeabilities. These results are compared with data from alternative laboratory measurements and with petrophysical properties inferred from downhole logging data.

We incorporate these results into a 2D numerical model that reflects the shelf architecture as known from drillings and seismic data to perform submarine groundwater flow simulations. In order to account for uncertainties related to the spatial distribution of physical properties, such as porosity and permeability, systematic variation of input parameters was performed during simulation runs.

The target is to test the two conflicting hypotheses of fresh groundwater emplacements offshore New Jersey and to improve the understanding of fluid flow processes at marine passive margins.