Goldschmidt 2023 Abstract
https://doi.org/10.7185/gold2023.15753

The modern freshwater component in Baltic Sea glacial clays

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Fluids migrating through marine sediments are not only capable of transporting dissolved materials, but may also be able to shape the seafloor morphology. Terraces formed in glacial clay have been observed in the seafloor of Stockholm archipelago as well as in some other locations around the Baltic Sea. These terraces have been hypothesized to be produced through one of the fluid migration mechanisms—submarine groundwater discharge (SGD). However, the hypothesis has not yet been possible to confirm, for example by tracing fluid migration using geochemical analyses of sediment porewater. Here we further investigate the potential links between SGD and the observed terraces through analyses of ^{222}Rn activity in Fifång Bay, located in Southern Stockholm Archipelago, as well as in terrestrial and marine sediment cores retrieved from Fifång Island and the surrounding waters. Results from ^{222}Rn mass balance calculations and analyses of water isotopes, salinity/chloride concentration, and a dual-carbon approach (radiocarbon dating and stable carbon isotopes) suggest that modern precipitation could flow through the glacial clay layers as well as fractured rocks of Fifång Island and further discharge into Fifång Bay. However, inconsistent trends of water isotopes and chloride together with dating of both marine sediment porewater and the sediment deposition suggest that there could be relatively young brine groundwater intrusion/infiltration in the glacial clays after they were initially deposited. Combined with geophysical mapping data, our geochemistry results imply that the source of brine groundwater could be derived from a deep confined aquifer, which through SGD might contribute to the formation of the observed terraces in glacial clay.