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Salinity driven groundwater flow in layered aquifer systems on the continental shelf during transgression

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Numerical simulations describing variable-density groundwater flow in a layered aquifer system underneath a continental shelf, undergoing transgression after a sea-level low stand, illustrate various modes of saline intrusion. Rapid salinisation will occur in shallow aquifers where free-convection of sea water into fresh water is dominant. In deeper aquifers a lateral migration of the salt-fresh interface accomplishes the expulsion of fresh water much more slowly than in the shallow aquifers. Model simulations show that as a result of the contrasting rate of salinisation of shallow and deep aquifers fresh water from deeper aquifers is forced into shallow aquifers. As a result the hydrodynamics of the shallow system remain unstable for much longer than would be expected if an inflow of deeper fresh water would not be considered. This and other results provide an extension of our view on the nature and dynamics of the process of aquifer salinisation across the continental shelves after sea-level low stand. Simulations like these are of particular relevance to our understanding of the extent and hydrodynamics of present-day fresh water occurrences in aquifers on the continental shelves world-wide, which have been flooded in the past millennia.