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Salinity origin of aquitard porewater in the Jiangsu coastal plain

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Groundwater resources have been threatened by seawater intrusion and also paleo-saltwater in the Jiangsu coastal plain. Porewater in the low-permeability clayey aquitard has long residence time and could be paleo saltwater which invade here during the transgression period. Investigating the chemistry of aquitard porewater plays vital role on groundwater extraction managements owing to wider distribution of aquitard in the coastal plain. In this study, chemical and isotopic compositions were analyzed in porewater squeezed from a clayey aquitard in Jiangsu coastal plain, eastern China, to interpret the salinity origin, chemical evolution and water-mass mixing process. A strong geochemical fingerprint was obtained with an aligned Cl/Br ratio of 154 in the salinized aquitard porewater over a wide Cl- concentration range (396–9720 mg/L), indicating that porewater salinity is likely derived from a mixing with old brine with a proportion of less than 20 %. Very small contributions of brine exerted limited effects on water stable isotopes. The relationships between porewater δ18O and δD indicate that shallow and intermediate porewaters could be original seawater and were subsequently diluted with modern meteoric water, whereas deep porewaters with depleted stable isotopic values were probably recharged during a cooler period and modified by evaporation and seawater infiltration. The cation-Cl relationship and mineralogy of associated strata indicate that porewater has been chemically modified by silicate weathering and ion-exchange reactions. 87Sr/86Sr ratios of 0.7094–0.7112 further confirm the input source of silicate minerals. Numerical simulations were used to evaluate the long-term salinity evolution of the deep porewater. The alternations of boundary conditions (i.e. the third aquifer mixed with brine at approximately 70 ka BP, followed by recharge of glacial meltwater at 20–25 ka BP, and then mixing with Holocene seawater at 7–10 ka BP) are responsible for the shift in porewater salinity. These timeframes correspond with the results of previous studies on ancient marine transgression-regression in Jiangsu coastal plain.