PROCESSES CONTROLLING THE PRESENCE OF SALTY GROUNDWATER IN THE RED RIVER FLOOD PLAIN

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Abstract. *Radiocarbon dating of sediments in 36 sub-recent deltas worldwide has shown, that the sediments began to accumulate within a restricted time range, from about 8,500 to 6,500 years ago (Stanley and Wide, 1994). Today, many of these deltas and their flood plains constitute multi-aquifer systems with saline paleowater. The Red River flood plain in Vietnam makes up such a multi-aquifer system, where saline groundwater is widespread occurring. We have studied the distribution of salty groundwater in this flood plain and established a conceptual model of the saltwater distribution, based on lithological information, geophysical borehole logging and transient electromagnetic soundings. In addition, the processes controlling the leaching of marine porewater from the sediments were analyzed with simple 1D numerical modelling using SEAWAT. The investigations reveal the presence of salty paleowaters up to 50-75 km from the coastline, and that the distribution of saltwater is controlled by marine deposits of the Holocene transgression. In the lower Pleistocene aquifer, the highest salinities is found below two intrinsic valleys with marine sediments. Recent intrusion of saltwater from the South Chinese Sea into shallow aquifers has been observed as far inland as 35 km from the coastline and is probably dominated by a storm and tide generated transport of seawater into rivers. The observed inverted salinity profile, with high saline water overlying fresh groundwater, is therefore a result of the presence of low permeable salty Holocene sediments overlying more coarse grained Pleistocene fluvial deposits. The results of the numerical modelling show that diffusion of solids out of the low permeable sediment is the most important process controlling the salinity distribution, when the sediment hydraulic conductivity is lower than 10-7 m/s. This process is slow, even in a geological time perspective, and explains why salinity concentrations up to 10-15 % that of seawater is still present in sediments far inland. In contrast, density driven transport of salts in the more high permeable sediments is a relatively fast process, which can flush the marine porewater out of the sediments within few tens or hundreds of years. The saltwater distribution in the Red River delta plain has many similarities with other reported occurrences of saltwater controlled by the global eustatic sea-level changes during the past 8,000 – 9,000 years.*

Keywords: Holocene transgression, SEAWAT, hydrogeophysics