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Genesis of economic relevant fresh groundwater resources in Pleistocene/ Neogene aquifers in Nam Dinh (Red River Delta, Vietnam).

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In the Southern Red River Delta (Nam Dinh Province, Vietnam), a local lens of low saline pore water of high quality has been identified in unconsolidated Pleistocene and Neogene aquifers, which are regionally known to contain brackish and saline pore waters. Since the 1990ies, ongoing overexploitation of the fresh groundwater results in decreasing GW heads up to 0.6 m/a and the development of a regional abstraction cone. The presented study focuses on distribution and genesis of fresh and saline pore waters and reflects the results in frame of the regional hydrogeological context.

Observations of the geological structure and groundwater dynamics combined with hydrochemical and isotopic studies suggest adjacent Triassic hard rock aquifers as the major source for fresh Pleistocene and Neogene groundwater. Salinization status in the economically most relevant Pleistocene aquifer has been studied based on archive and new hydrochemical and geophysical data. Own hydrochemical field studies as well as laboratory measurements of the specific resistivity of dry sediment samples allow the translation of induction logging data from existing monitoring wells into vertical pore water salinity profiles. This approach suggests the regional occurrence of saline pore water in shallow Holocene sediments in the working area, as confirmed by pore water studies in Hoan et al. (2010).

Interpretation of induction logging and stable isotope data suggest vertical diffusion of saline pore water in shallow Holocene sediments as a source for high saline pore water in deeper aquifers. Analytical diffusion modeling for a period of 3000 years confirms that vertical diffusion of Holocene paleo-sea water can explain saline pore water in Pleistocene and Neogene aquifers in a stagnant environment. The constant influx of fresh groundwater from adjacent Triassic hard rocks results in flushing of the primary Pleistocene and Neogene pore water and inhibits the infiltration of saline water from marine Holocene sediments.

Consequently, 14C groundwater age dating suggests increasing groundwater ages from fresh to saline pore water in Pleistocene and Neogene up to 14 ka, presuming that contamination with dead carbon is neglectable. Highest 14C ages of low saline water has been observed in the center of the exploited fresh water lens reaching up to 10 ka, reflecting low groundwater flux and recharge rates. Due to the overexploitation, the natural coastward directed groundwater flow has turned towards the centre of the abstraction cone with horizontal apparent velocities of up to 0.6 m/a. This suggests, that brackish and higher saline groundwater from the Red River area (East Nam Dinh) and offshore migrates towards the fresh water lens.

Thus, more sustainable exploitation strategies urgently must be implemented to reduce overexploitation of limited and valuable fresh groundwater resources in Nam Dinh Province.

Reference:

Hoan H., Pham Q. N., Larsen F. Tran L. V., Wagner F., Christiansen A.V. (2010): Processes Controlling High Saline Groundwater in the Nam Dinh Province, Vietnam. 2nd Asia-Pacific Coastal Aquifer Management Meeting (ACAMM), October 18-21, 2011, Jeju Island, Korea.