Groundwater quality distribution in the Belgian coastal plain: a story of Holocene transgression and human intervention

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Groundwater quality distribution in coastal plains is in many cases complex and determined by many factors acting on different (time) scales: geological evolution of the coastal plain, climate, hydraulic and geochemical properties of the subsurface and human intervention. This applies also for the Belgian coastal plain where we come across a complex fresh-salt water distribution in the Quaternary phreatic aquifer.

This fresh-water distribution was studied intensively in the last 50 years resulting in for instance the well-known map depicting the depth of the fresh-salt water interface of De Breuck *et al.* (1974). Since the publication of this map, many new data has been collected going from specific studies to results from monitoring networks. This data has been used recently to revisit the fresh-salt water distribution in the central part of the coastal plain (between Nieuwpoort and Zeebrugge) (Vandenbohede *et al.*, 2010). Also the detailed geochemistry of the pore water was studied (Vandenbohede and Lebbe, in press a) for this study area.

Only minor differences with regard to the fresh-salt water distribution mapped by De Breuck *et al.* (2010) were encountered. This shows that the distribution has not undergone considerable evolutions over the last 35 years. Or it means in general that the fresh-salt water distribution is currently in equilibrium with the stresses (e.g. water levels in ditches and canals, recharge, etc.). This situation is also confirmed by simulations of the fresh-salt water evolution in the coastal plain (e.g. Vandenbohede *et al.*, in press b). Notable exceptions are areas where recent and important infrastructural interventions have taken place (e.g. large pumping for building sites, etc.).

Hydrochemistry of the pore water is determined by the displacement of saline by fresh water or vice versa. This triggers typical reactions such as cation exchange and carbonate dissolution. Additionally, a number of redox reactions such as oxidation of organic material is also important. Fresh water lenses in the aquifer are mainly the result of human intervention: impoldering led to a displacement of the older saline water by fresh recharge water. Whereas this last 1000 years is thus typified by freshening, both signatures of freshening and salinization are found in the older saline water. It is a relic of the complex Holocene transgression history: there were successive phases where saline North Sea water had a different influence on the aquifers recharge. Consequently, geochemistry and combination of flow and geochemical modelling can add to the knowledge of our coastal plains evolution.

Understanding the chemical status in a coastal aquifer and the processes determining it is a prerequisite for effective and sustainable management, especially when recognising future challenges posed by climate change. Increasing sea level changes the sea boundary of the coastal aquifer. Changing climatic parameters means that recharge patterns will change. Both will influence for instance the drainage system and hence influencing an important boundary condition of the groundwater system: fresh-salt water distribution and water quality will change in the future (e.g. increased salt load to the polders).

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