



Regional aquifer geochemistry below the Boom Clay (NE-Belgium): data analysis and modelling

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For more than 35 years, SCK•CEN has been investigating the possibility of high-level and/or long-lived radioactive waste disposal in the Boom Clay in NE-Belgium, including the study of the regional hydrogeology and geochemistry of the aquifer systems surrounding the Boom Clay. This study presents the analysis and modelling of groundwater geochemistry in the confined aquifers below the Boom Clay in NE-Belgium. This so-called deep aquifer system includes, with increasing depth, parts of the Oligocene Aquifer System, The Bartoon Aquitard System and the Ledo-Paniselian-Brusselian Aquifer System.

At the end of the Neogene period, during which several marine transgressions and regressions took place, the sea definitely drew back after having deposited shallow marine and estuarine sands and some clay. The original seawater in the pores of the sediments was in first instance gradually diluted as the aquifer was flushed by recharge (fresh) water. Afterwards, water-rock interactions, including cation exchange, began to play a role in the deep aquifer system. This led to changes in groundwater composition over time.

Geochemical data (major ions, stable isotopes, radioactive isotopes, dissolved gases) have been collected at a regional scale from the piezometric network in the deep aquifer system. Several measurement campaigns have been performed between 1980 and 2010. Groundwater is currently mainly of Na-HCO₃ to Na-Cl type water, and because of the low groundwater velocity, re-equilibration with the host formations generally occurs. The main geochemical indicators (salinity, stable isotopes) point to a mixture between saline water (to the NW) and fresh recharge water (from SE). SE-NW gradients of ion concentrations are observed and can be explained in agreement with the pattern of natural groundwater flow.

Building on the concepts emerging from the geochemical data analysis and recent groundwater modelling, a geochemical model was developed in PhreeqC, using geochemical and mineralogical data. Calculations were done for several locations in the deep aquifer system.