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ANTHROPOGENIC CONTAMINATION OF A PHREATIC DRINKING WATER WINNING: 3-DIMENSIONAL REACTIVE TRANSPORT MODELLING

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Groundwater is contaminated at the regional scale by agricultural activities and atmospheric deposition. A 3-D transport model was set-up for a phreatic drinking water winning, where the groundwater composition was monitored accurately. The winning is situated at an area with unconsolidated Pleistocene deposits. The land use is nature and agriculture. Annual mass-balances were determined using a wide range of historic data. The modelling approach for the unsaturated zone was either simple box models (Cl, NO_3 and SO_4) or 1-D transport modelling using HYDRUS (Cd). The modelling approach for the saturated zone used a multiple solute version of MT3D, where denitrification associated with pyrite oxidation and sorption of Cd were included. The solute transport calculations were performed for the period 1950–2030. The results obtained for the year 2000 were used as input concentration for the period 2000–2030. A comparison between the calculated and the measured concentrations of groundwater abstracted for Cl, NO_3 and SO_4 yields the following. First, the input at the surface is rather well estimated. Second, the redox reactivity of the first two aquifers is negligible around the winning, which is confirmed by respiration experiments using anaerobically sampled aquifer sediments. The reactivity of the third aquifer, which is a marine deposit and lies at least 30 meters below surface, is considerable. The discrepancies between modelled and measured output are explained by lack of knowledge about the subsurface reactivity and/or wrong estimates of surface loading and leaching from the unsaturated zone. The patterns for other hydrogeochemical variables such

as Ca, HCO_3 may further constrain this lack of knowledge. The results for Cd indicate that Cd becomes strongly retarded, despite the low reactivity of the sandy sediments. The winning is rather insensitive to Cd contamination (but the surface water drainage network is not). Two major uncertainties for input of Cd exist: composition of rain before 1970 and use of sewage sludge as manure in the past.