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Isotope methods as a tool to characterize nitrate origin and transport in Kocinka catchment (central Poland): preliminary results

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Kocinka catchment with 258 km2 of surface area is one of the Soils2Sea project (BONUS programme) case studies. One of the main scientific objectives of this project is to analyze how changes in land use and climate may affect the nutrient load to the Baltic Sea. Hydrogeological conditions in the Kocinka catchment are determined by Quaternary glacial till and glacifluvial sands and gravels underlain by karstic-fractured limestones which compose the Upper Jurassic Major Groundwater Basin (MGWB 326), one of four most important groundwater reservoirs in Poland. Pollution with nitrates is the most important threat to groundwater quality in this groundwater body. The concentration of nitrate in some wells, in the southern part of Kocinka catchment where outcrops of Jurassic limestones occur, exceeds the maximum permissible level of 50 mgNO_3/L and constantly increases. A prerequisite for measures to reduce NO_3 loads to the groundwater body is identification of sources of nitrate pollution. The working hypothesis links the high nitrate concentrations with the leaking sewage system in Czestochowa city and its surroundings but agricultural sources cannot be excluded as 66% of Kocinka catchment area is used agriculturally.
A dedicated study employing environmental tracers was launched with the main aim of quantifying the pathways and dynamic of groundwater flow in the aquifer. Tritium was found throughout the system but its concentrations vary considerably. Decrease of tritium contents with depth in the aquifer was observed in one of wells. This points to active recharge and characteristic time scales of groundwater flow in order of years to several decades. To identify the origin of nitrate pollution nitrogen and oxygen isotope ratios of dissolved nitrate was analyzed in a number of wells with high nitrate concentrations. The isotopic composition of dissolved nitrates does not confirm the hypothesis on the decisive role of urban sewage in nitrate pollution. The isotope date point to agriculture as the main source of NO_3. The isotopic data provided no evidences for natural denitrification in the aquifer. However, only water samples with considerable amounts of nitrates were analyzed for 15N and 18O. On the other hand, low NO_3 concentrations in the deeper part of aquifer can be due to denitrification or long residence time of this water.

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