

Use of chemical data for verification of groundwater flow conditions (Lwówek region, Poland)

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ABSTRACT

Regional recharge zones are characterized by high downward gradients which enable contaminants to migrate downward to deep parts of the flow system. In the areas dominated by agriculture the contamination is related mainly to nitrate. In the regional recharge zone of Quaternary aquifers located in central Wielkopolska (Lwówek region, Poland) relatively high nitrate concentrations ($>15 \text{ mgNO}_3/\text{l}$) were detected at a great depth ($>80 \text{ m}$). To explain the origin of high nitrate concentrations, multilevel piezometer nests were constructed for documentation of vertical nitrate migration at 3 selected locations, where hydrogeological windows were indicated (sands and gravels in the geological profiles). It was shown that in the shallow part of the aquifer, the concentration of nitrates exceeds $30 \text{ mgNO}_3/\text{l}$. The nitrates migrate downward to the deepest parts of the flow system in regions of groundwater extraction (where high nitrate concentrations are detected at a great depth). Under natural conditions (where the water extraction is not performed), this contamination is not yet observed in the deep part of the flow system. Based on this research, a conceptual model of groundwater circulation was formulated. The most intensive groundwater recharge occurs in the unconfined parts of the flow system in the regions of groundwater extraction. In the regions where natural gradients exist (without water extraction) the recharge in shallow parts of the aquifer is also intensive but young water does not reach deeper parts of the flow system, where stagnation zones typically exist (as defined by Tóth, 1963), and is manifested by completely different groundwater chemistry than in shallow parts of the aquifer. The presented research is a great example of how chemical data can be used to help investigate groundwater circulation.

This work has received funding from the National Science Centre of Poland (grant no. 2014/15/B/ST10/00119).