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Water and anion transport conversion in highly heterogeneous, recultivated open mining fields with very different carbon levels and pH values: multitracer lysimeter studies

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The movement of water and the related transport of bromide and nitrate were studied in soil used for agriculture from an open mining field near Espenhain/Saxony by means of tracer techniques (D_2O, [^{15}N]nitrate, Br tracer) in monolithic and reconstructed lysimeters. Despite the similarly high level of seepage, the breakthrough volumes were very different, namely 82 1 (L 12/1), 147 1 (L 12/3) and 30 1 (L124) for D_2O. After the experiments had continued for 36 months, the recovery standardised for 600 1 seepage of bromide and deuterium respectively were calculated to be 22% and 39% for L 12/1, 15% and 19% for L 12/3, and 4% and 46% for L 124. The differences in the seepage recovery of the reactive tracer [^{15}N] nitrate were even greater for the three lysimeters, namely 3,7% (L 12/1), 0.7 % (L 12/3) and 1.5 % (L 124).

The findings regarding the transport of D_2O indicate that water transport in the soil monolith of L 12/1 is mainly determined by preferential flow, whereas in L 12/3 and L 124 conditions are largely shaped by piston flow and delays corresponding to the cascade model. Taking into account plant uptake, the sometimes much lower recovery of bromide compared to D_2O in lysimeter L 12/1 and especially in L 124 couid be attributed to reactions resulting from the strong acidic conditions (pH 1.5–2.0) in the soil water of these lysimeters, the extremely high sulphate levels (over 4%) and/or the reactive carbon from lignite residues. Under these conditions, the bromide appears to undergo temporary chemisorption and possibly even chemical conversion. The seepage recovery of [^{15}N] nitrate in the open mining field soil is significantly lower than in natural soils. [^{15}N] nitrate recovery in 600 1 seepage of 3.7% (L 12/1), 0.7% (L 12/3) and 1.5% (L 124) are probably caused by nitrate decomposition via denitrification under the partly extreme soil conditions.