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Probability of contaminant migration from abandoned in-situ coal conversion reactors

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In the context of a potential utilisation of coal resources located in the Mecsek mountain area in Southern Hungary (Püspöki et al.. 2012), an assessment of groundwater pollution resulting from a potential water-borne contaminant pool remaining in in-situ coal conversion reactors after site abandonment has been undertaken. The respective contaminants may be of organic (i.e., phenols, benzene, polycyclic aromatic hydrocarbons, etc.) and inorganic nature (i.e., ammonia, mercury, zinc, cyanide, heavy metals, etc.), whereby data for the Mecsek coal has been derived from extensive laboratory testing.

The probability assessment was carried out by means of numerical simulations of fluid flow as well as contaminant and heat transport including retardation using the TRANsport Simulation Environment (Kempka, 2020). Hereby, the main uncertainties, e.g., changes in hydraulic gradient and hydraulic contributions of the complex regional and local fault systems in the study area, were assessed in a deterministic way to identify the parameters relevant for the overall sensitivity study. Using Monte-Carlo analyses and Latin hypercube sampling, the uncertainty bandwidths of water table, retardation factors, dispersion coefficients, hydraulic conductivities of aquitards, faults and aquifers as well as groundwater recharge were considered.

The simulation results demonstrate that fluid flow via the regional faults is the main driver for a potential contamination of the shallow groundwater aquifers. Consequently, the numerical simulation results on potential fault reactivation due to coal extraction (Hedayatzadeh et al., 2022) were taken into account in view of probable hydraulic conductivity changes in the regional fault systems and the rock matrix surrounding the abandoned reactors. The probabilities of groundwater aquifer contamination within a time horizon of 50 years are presented based on maximum contaminant concentrations, cumulative mass balances as well as migration distances of the contaminant plume. The results of this analysis are essential for mining authorities as well as potential stakeholders to improve the understanding on potential environmental impacts, and

have been integrated into a specific toolkit for risk assessment (Tranter et al., 2022) for that purpose.

References

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