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# Assesment for Water Flow and Solute Transport in Tailings Piles: a numerical modeling to design an artificial tracer test

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The former uranium mine, Le Cellier, located in South of France, offers an opportunity to investigate the unsaturated flow and solute transport through a tailings pile resulting from heap leaching under real-world conditions (Ouedraogo et al., 2022; L'Hermite et al., 2024). Numerical simulations of one of the tailings pile were conducted to model the dynamics of the water flow. In order to tackle quality issues and to validate the hydrogeological model, we plan to make an artificial tracing test experiment. We developed a solute transport model for this pile to help the design of this experiment that will be carried out in the next future.

Conceptual one-dimensional (1D) systems representing the pile were simulated using the HYDRUS code for flow and conservative transport. The first results show that the model generates breakthrough curves exhibiting the same dynamics, irrespective of the top concentration of the injected dissolved solute. High values of hydraulic conductivity and longitudinal dispersivity accelerates solute transport, resulting in higher concentration peaks. Dual-porosity models yield significantly shorter residence times compared to single-porosity models, particularly during dry periods. The impact of climatic conditions before and during the tracer injection as well as the injection method have been also evaluated with this model.

These findings suggest that artificial tracer experiments in the studied pile should be conducted under wet conditions and give useful information for the field implementation of the test. This simulation approach provides valuable insights for designing effective and realistic tracer test experiments. Our study shows that this type of field and modeling approach of tracer testing can help in mine water management strategies.