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Water chemical evolution in Underground Pumped Storage Hydropower plants and induced consequences

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Underground Pumped Storage Hydropower (UPSH) using abandoned mines is an alternative to manage the electricity production in flat regions. UPSH plants consist of two reservoirs; the upper reservoir is located at the surface or at shallow depth, while the lower reservoir is underground. These plants have potentially less constraints that the classical Pumped Storage Hydropower plants because more sites are available and impacts on landscape, land use, environment and society seem lower. Still, it is needed to consider the consequences of the groundwater exchanges occurring between the underground reservoir and surrounding porous media. Previous studies have been focused on the influence of these groundwater exchanges on the efficiency and on groundwater flow impacts. However, hydrochemical variations induced by the surface exposure of pumped water and their consequences have not been yet addressed.
The objective of this work is to evaluate the hydrochemical evolution of the water in UPSH plants and its effects on the environment and on the UPSH efficiency. The problem is studied numerically by means of reactive transport modelling. Different scenarios are considered varying the chemical properties of the surrounding porous medium and groundwater. Results show that the dissolution and/or precipitation of some compounds may affect (1) the groundwater quality, and (2) the efficiency and the useful life of the used pumps and turbines of the UPSH system.