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Mines as lower reservoir of an UPSH (Underground Pumping Storage Hydroelectricity): groundwater impacts and feasibility

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The energy framework is currently characterized by an expanding use of renewable sources. However, their intermittence could not afford a stable production according to the energy demand. Pumped Storage Hydroelectricity (PSH) is an efficient possibility to store and release electricity according to the demand needs. Because of the topographic and environmental constraints of classical PSH, new potential suitable sites are rare in countries whose topography is weak or with a high population density. Nevertheless, an innovative alternative is to construct Underground Pumped Storage Hydroelectricity (UPSH) plants by using old underground mine works as lower reservoir. In that configuration, large amount of pumped or injected water in the underground cavities would impact the groundwater system. A representative UPSH facility is used to numerically determine the interactions with surrounding aquifers Different scenarios with varying parameters (hydrogeological and lower reservoir characteristics, boundaries conditions and pumping/injection time-sequence) are computed. Analysis of the computed piezometric heads around the reservoir allows assessing the magnitude of aquifer response and the required time to achieve a mean pseudo-steady state under cyclic solicitations. The efficiency of the plant is also evaluated taking the leakage into the cavity into account. Combining these two outcomes, some criterions are identified to assess the feasibility of this type of projects within potential old mine sites from a hydrogeological point of view.