An old slate mine as lower reservoir for UPSH (Underground Pumping Storage Hydroelectricity)- groundwater interactions and limitations
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Pujades Estanislao, Liège, Belgium

estanislao.pujades@ulg.ac.be

Bodeux Sarah, Bât. B52 3 - Hydrogeology and Environmental Geology, Liège, Belgium

Orban Philippe, University of Liège, ArGEnCo, GEO3, Hydrogeology and Environmental Geology, Liège, Belgium

Brouyère Serge, University of Liège, ArGEnCo, GEO3, Hydrogeology and Environmental Geology, Liège, Belgium

Dassargues Alain, University of Liège, ArGEnCo, GEO3, Hydrogeology and Environmental Geology, Liège, Belgium

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Renewable energy sources have an increasing role to play in the future energy framework but their intermittence cannot afford a stable production according to the demand. Pumped Storage Hydroelectricity (PSH) is an efficient technology to store and release electricity. However, the development of new PSH plants is limited by environmental and topographic constraints. An innovative alternative consists in using old underground mines as lower reservoirs of Underground Pumped Storage Hydroelectricity (UPSH) plants. In this configuration, large amount of water is pumped and injected in underground cavities and these cyclic stresses impact the groundwater system. A hybrid 3D finite element mixing cell method is used to numerically simulate the use of an UPSH facility, in the case of an abandoned slate mine. Different scenarios are computed with varying pumping injection time-sequences. In order to assess the impact on the surrounding groundwater conditions, the resulting head evolution in the cavity and at different distances is analyzed in terms of groundwater oscillation magnitude, drawdown, and seepage into the cavity. Results show clearly the influence of the pumping injection time-sequence (rates, regularity, timing and duration of no-activity periods) on the actual head evolution in the surrounding medium and consequently on the magnitude of interactions with the cavity. For a given hydraulic conductivity of the surrounding medium (i.e. slates in this case study), the main conclusion is that the resulting interaction seepage flows (in and out of the cavity) are highly dependent on the chosen pumping injection sequences. The future impact of UPSH operation must be assessed taking this fact into account.