Hydrogeochemical impact assessment of pumped hydro power storage in open-pit lignite mines

Tobias Schnepper[1,2], Michael Kühn[1,2], Thomas Kempka[1,2]
[1] GFZ German Research Centre for Geosciences, Fluid Systems Modelling, Potsdam
[2] University of Potsdam, Institute of Geosciences, Potsdam

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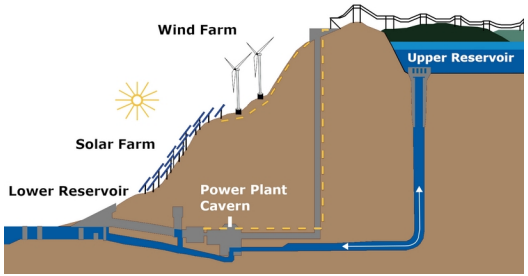

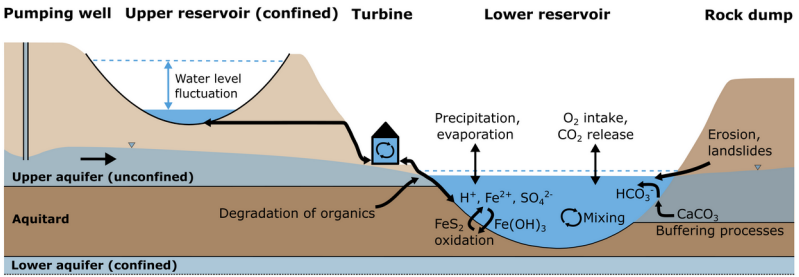

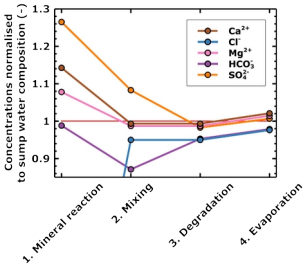

schnepper@gfz-potsdam.de

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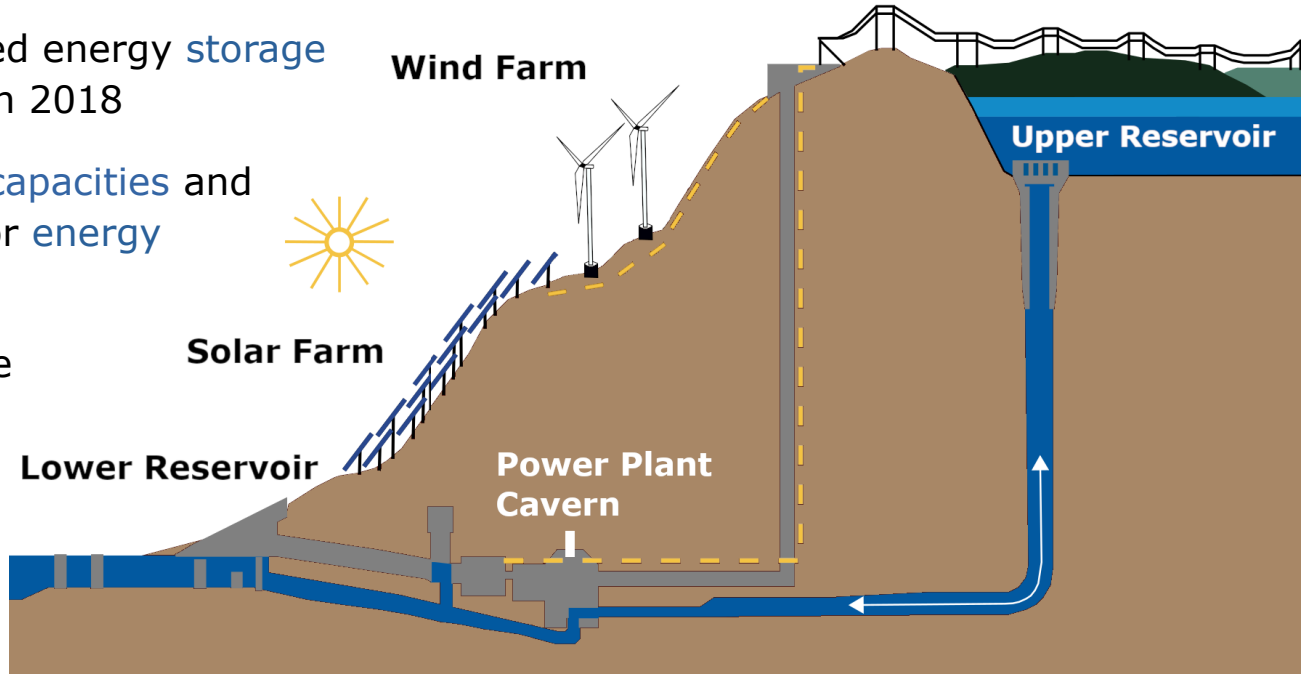
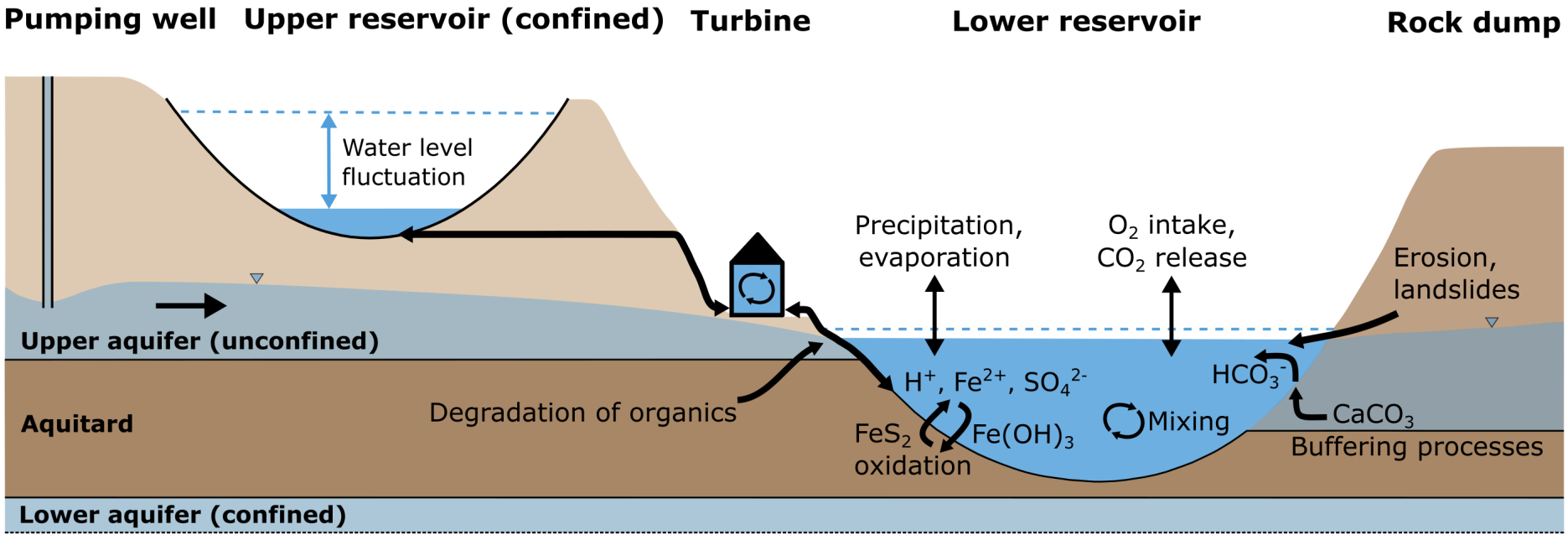
Hybrid pumped hydro storage can substantially contribute to required economically beneficial energy storage capacities

- ~97% of worldwide installed energy storage capacity provided by PHS in 2018
- Additional energy storage capacities and supply securities needed for energy transition
- HPHS construction in lignite mines technically feasible
- Hydrogeochemical and environmental impacts not yet assessed



Hunt et al. (2020)
Thema and Thema (2019)

Conceptual hydrogeochemical model developed based on local hydrogeology, long-term water and sediment data



Akcil and Koldas (2006)
Lenk and Wisotzky (2011)

Forward model confirms findings assuming thermodynamic equilibrium and successfully describes chemical reaction path

Rain water
pH: 5.5

Run-off

1. Mineral reactions

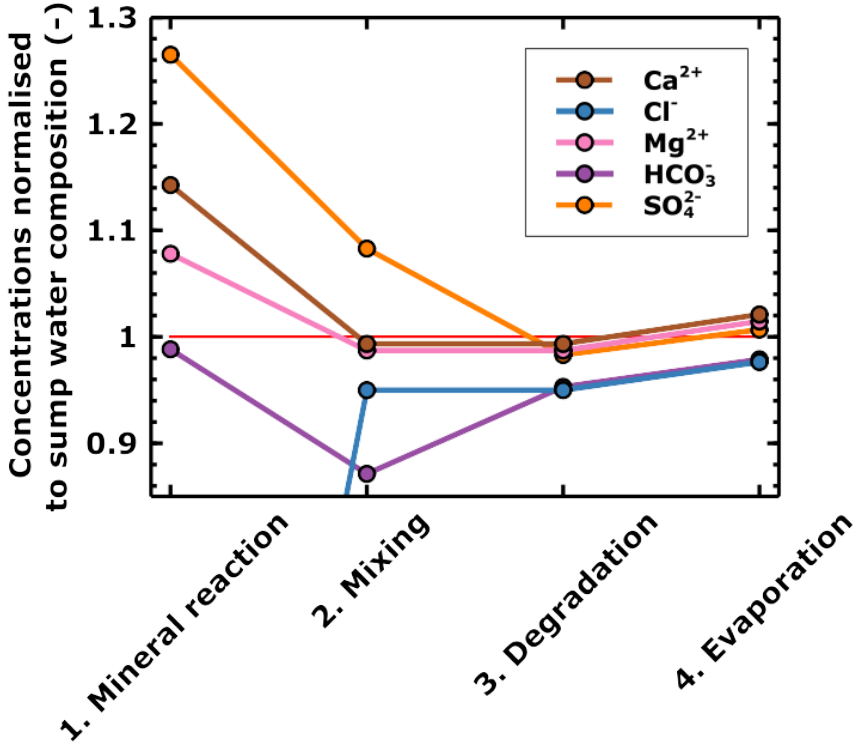
Dolomite	until saturation
Calcite	until saturation
Pyrite	2.0 mmol kgw^{-1}
$Fe(OH)_3(a)$	precipitation
O_2, CO_2	atm

Groundwater
pH: 7.8

2. Mixing
80 % Run-off
20 % Groundwater

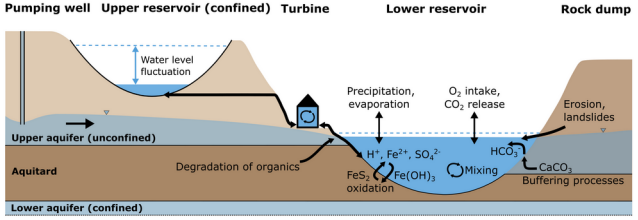
3. Degradation
1.7 mmol kgw^{-1} of CH_2O

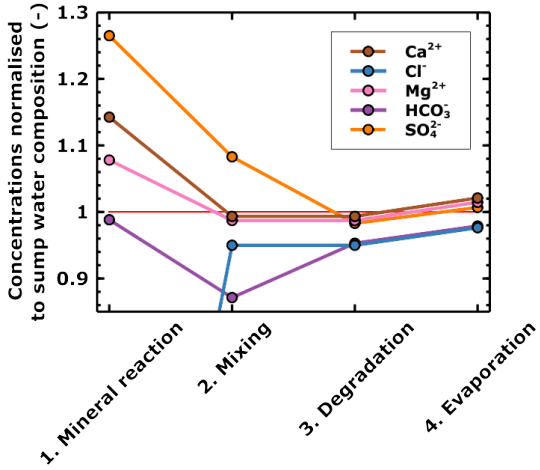
4. Evaporation
5 % of sump water



Successfully validated reaction path models will serve as basis for environmental assessment of PHS operation in lignite mines

- Experiences from lignite mine flooding emphasise importance of hydrogeochemical processes for HPHS implementation
- Inverse and reaction path models derived from conceptual hydrogeochemical model and validated against field data





Ongoing work

- Sediment and water sample analysis for test sites
- Groundwater flow model to simulate influence of water level change on groundwater flow during PHS operation
- Simulation of groundwater - reservoir interaction by coupled reactive transport modelling

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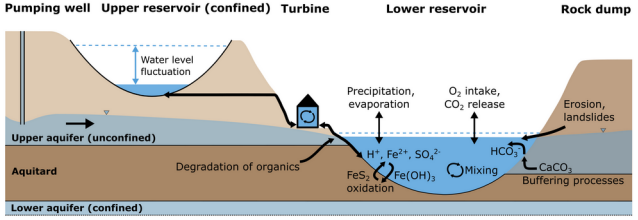

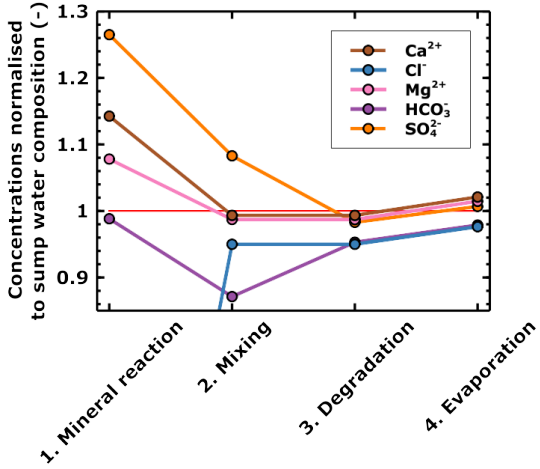

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Thank you for your attention!