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Implementation of hydrogeological and geochemical models in new strategies for Li extraction in salt flat

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The climate emergency impacts settlements, infrastructures and ecosystems both through permanent flooding of the lowest-lying areas and by increasing the frequency and/or severity of storm surges over a much larger region. In response to these challenges, the urgency in green renewable energies transition and vehicle electrifications to reduce the greenhouse gases emissions aligns with the growing need for enhanced electrical storage capacity, predominantly reliant on Li-based batteries. Notably, Li extraction is predominantly sourced from brine pumping and evaporation in salt flats, arid environments necessitating a shift toward Zero-Water consumption in extraction procedures. With this objective, mining companies have proposed a new extraction methodology based on Li recovery without evaporation and later brine reinjection in the aquifer, reducing at the same time cost and environmental impact, aligning with Horizon Europe cluster 5 of agenda 2030. Our research aims to develop a novel hydrogeochemical framework that helps to understand the effect of brine reinjection in salt flat, combining 3 fundamental research plans: 1) the hydrogeological characterization in salt flat focused to find the most favorable areas for brine injections, as well as monitoring the evolution of hydrological parameters at the aquifer during injection test for later implementation in 3D models. 2) the hydromechanical analysis of surface deformation associated with brines injection, looking to calculate the storage capacity and identify hydrogeological discontinuities. 3) the geochemical framework around brine mixing and brine-rock interactions affronted by modeling, lab and field samples characterization for later implementation in reactive transport models. A reinjection test carried out at Atacama salt flat has been studied by analyzing the generated hydrogeological and geochemical data, combined with historical deformation data. Descents in phreatic level influenced by injection have been characterized and included in a transport model. Geochemical reactions, including brine mixing and brine-rock interactions have been also characterized by reactive transport models calibrated with field data. Elucidating the whole set of geochemical processes that affect salt flats, as well as their combination with hydrogeologic and interferometric analysis will help to adapt predicting 3D models to new extraction strategies.