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Raw material mobilization from reservoir rock matrix under simulated geothermal conditions

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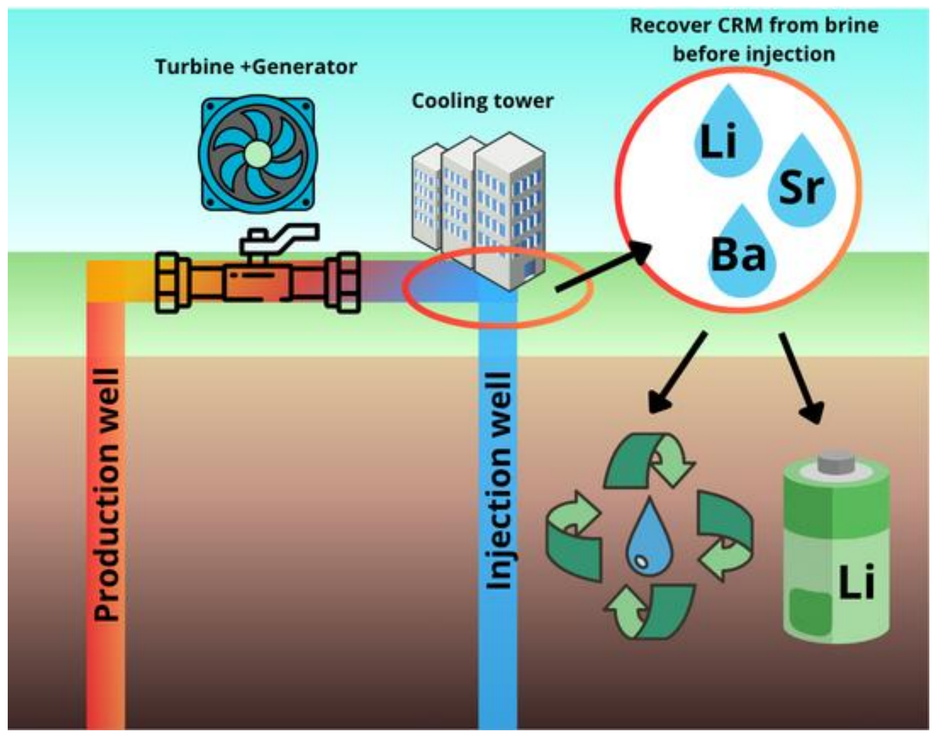
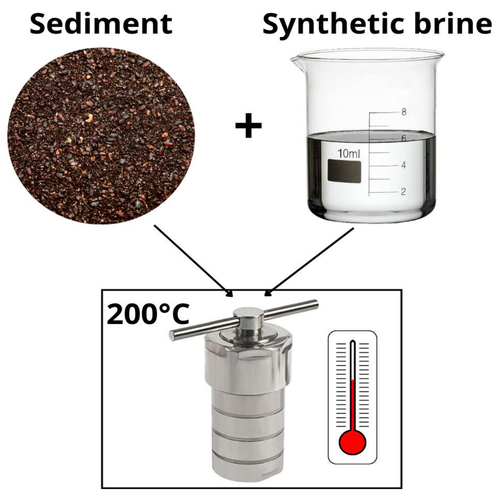
Introduction

The change from conventional energy to renewable energies to reduce climate change requires an increasing demand in critical raw materials (CRM), limited in Europe (Goldberg et al., 2023). To reduce dependence on importing components, **The Thermlon project** search the **extraction of CRM from geothermal brines** (e.g. Li, Ge, B), by leveraging the infrastructure of geothermal plants, thereby maximizing its use with a minimal invasive technique for the environment (Img 1), taking into account a factor that is rarely considered: **the sustainability of the aquifer, by calculating the long-term replenishment of elements in the fluids.**



Img 1. Procedure of energy production in a geothermal plant, plus extraction of CRM.

Work to date



Img 2. Diagram of leaching experiments methodology.

Analogues from aquifer rock of the Upper Rhine Graben (Buntsandstein Fm.) in the North Black Forest were collected. The rock were crushed to achieve 1-0.5 mm of sediment. A synthetic brine was created based in the chemical composition from the Graben Neudorf (Na 32,900 mg/L, K 3,670 mg/L and Ca 7,180 mg/L).

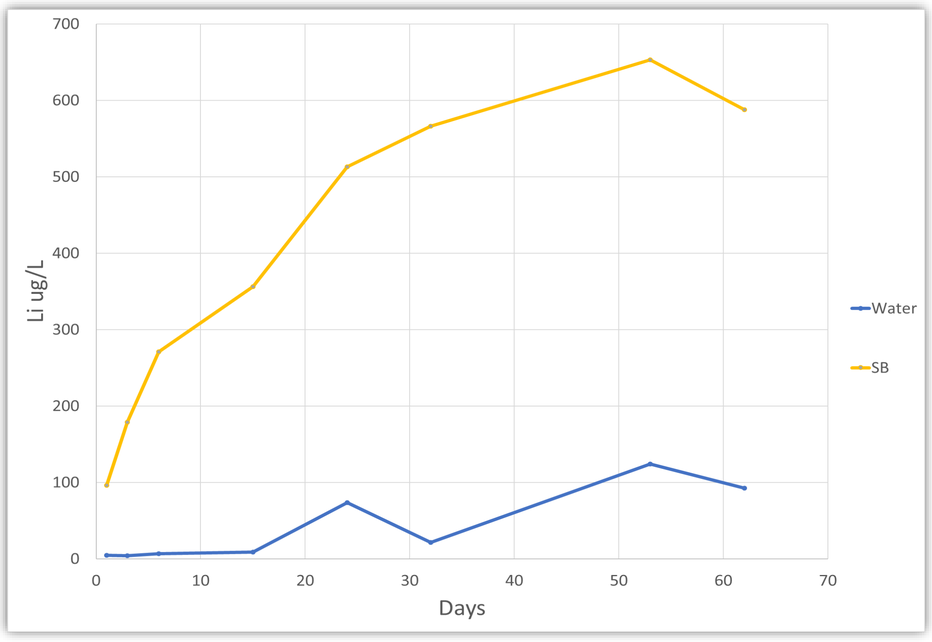
Then, 20 gr of the sediment were placed with 40 ml of the brine in a Hydrothermal Autoclave Reactor vessel kettle with PTFE chamber (Img 2). The leaching experiments were performed under geothermal conditions at 200°C and 16 bar for a time set of 62 days. The resulting fluid were measured using ICP-MS.

Results and discussion

The temporal evolution of the analyzed elements of interest showed distinct behaviors:

1. Progressive dissolution (Img 3): **Li, B.**
2. Ups and downs, rebalancing: **Ni, Sr**.
3. Close to equilibrium: **Cu, Ba.**

This results, plus a low lixiviation rate (2-15%) could indicate an stable reservoir and low-reactive rock into the solution under strong mineralogical control, which suggests a high degree of stability from an environmental and geochemical perspective, representing stability for the future.



Img 3. Develop of Li during the experiments, showing progressive dissolution.

Next steps

- Determine mineral composition of the elements and their mobilization into fluids.
- Numerical modeling based in geological features (THOUGHREACT and PetraSIM).
- Provide breakthrough years, possible extraction rates and predict the natural recharge time of the elements.

https://thermion.info/

Goldberg, V., Dashti, A., Egert, R., Benny, B., Kohl, T., & Nitschke, F. (2023). Challenges and opportunities for lithium extraction from geothermal systems in Germany—part 3: the return of the extraction brine. Energies, 16(16), 5899.

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