About us

CRM-geothermal is a research project funded by the European Union to develop an innovative technology solution that will combine the extraction of mineral raw materials and geothermal energy in a single process.

Why?

- Europe aims to reduce its environmental footprint by increasing the percentage of renewable energy sources. Wind turbines, photovoltaics and electric cars require however a large amount of mineral raw materials.
- Many of these materials are considered as 'critical raw materials' (CRM) by the European Union but are imported from non-European countries where environmental and ethical standards may be less strict than in Europe.
- Europe is highly dependent on minerals and energy imports which contributes to the current supply chain disruptions and the energy crisis.

How can we contribute?

- Geothermal is a renewable energy resource from the ground that is available 24 hours a day in Europe.
- Some types of geothermal fluids contain important amounts of CRMs.
- Collecting CRM data on geothermal fluids across Europe.
- Understanding the geological settings for the CRM enrichments in nature.
- Developing extraction methods to seperate the CRM from the geothermal brine.

Who we are

Our project is coordinated by the Helmholtz Centre for Geosciences (GFZ) that is based in the north of Germany, close to Berlin.

We are a research consortium consisting of more than 35 institutions in total and we involve academic and industry partners both from the geothermal and the mineral raw materials area.

Why we matter

Combining the extraction of heat and minerals from geothermal sources in a single technology solution has a series of advantages:

- It reduces the environmental impact by extracting two things at once.
- It avoids legacies from mining activities by directly extracting metals from geothermal fluids.
- It has almost zero carbon footprint.
- It supports the development of a more ethical and resilient supply chain for critical raw materials.
- It reduces our dependency on imports from third countries, which are exposed to market and geopolitical risks.

"Co-production of critical raw materials and heat from geothermal brines can reduce the EU's dependency on imported critical raw materials by diversifying and securing a domestic and sustainable supply of these materials. We already know that some geothermal fluids carry a substantial amount of Lithium, which could be extracted for the domestic supply chains of electric vehicle batteries. In CRM-geothermal, we widen the research by investigating also the abundance of other CRMs in geothermal fluids and developing extraction methods for selected elements, such as Lithium, Strontium or Helium. Therefore, the results from the CRM-geothermal project will be supporting the aims of the Critical Raw Material Act as well as the REPowerEU plan."

Katrin Kieling
Project Manager

Useful resources

First press release

Latest news

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Illustration: Leonnidas
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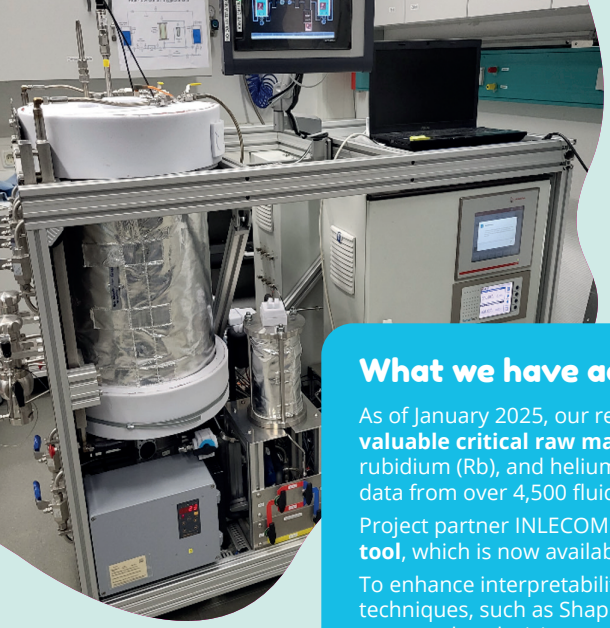

What we have achieved so far

As of January 2025, our research has shown that **geothermal fluids contain valuable critical raw materials (CRMs)** such as lithium (Li), strontium (Sr), rubidium (Rb), and helium (He). Our CRM-geothermal database now includes data from over 4,500 fluid samples.

Project partner INLECOM has developed an **AI-powered lithium estimation tool**, which is now available online: https://crm.inlecom.eu

To enhance interpretability in lithium estimation, Explainable AI (XAI) techniques, such as Shapley values, have been integrated into the tool. This ensures that decision-making processes remain transparent, giving researchers and industry professionals confidence in the results.

We have **tested six extraction technologies at the lab scale**:

- Four for lithium extraction
- One for helium extraction
- One for alkaline metals

In addition to established methods like adsorption and ion exchange, the project is also pioneering biotechnology-based lithium extraction approaches:

- Biosorption technologies: Researchers from Dr. Brill+Partner GmbH have been investigating biosorption methods, where biological materials selectively absorb lithium from geothermal brines.
- Bioprecipitation using microbial metabolism: The University of Neuchâtel is exploring an innovative bioprecipitation technique by combining two microbial metabolisms:
  - Fungal oxalic acid production to interact with lithium in solution
  - Bacterial degradation of oxalic acid/oxalate to induce lithium precipitation

Finally, we are developing **guidelines to apply the United Nations Framework Classification for resources (UNFC) for a combined extraction of geothermal energy and critical raw materials**. The UNFC is a globally recognised system for assessing and reporting mineral, energy, and other resources. It establishes a consistent and transparent framework to evaluate resource availability, technical feasibility, and environmental and social factors.

Pilot Testing in Cornwall

At the Cornish Lithium Plc. site in Cornwall, UK, we conducted hydraulic and geochemical monitoring in 2023. The results showed:

- The reservoir is extremely permeable, which means high productivity potential.
- The fluid chemistry is similar to seawater but enriched in lithium.

The next step is the implementation of a miniplant, demonstrating one CRM extraction technology.

We are also developing guidelines for obtaining a social licence to operate for combined extraction, which are being tested in Cornwall.

Learn more in our CRM-geothermal dictionary series

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