Student Story – Serhat Tonkul: 3D modeling and defining geothermal fluid properties at saline geothermal system, Western Turkey

by crm | Jun 19, 2026 | Uncategorized | 0 comments

Serhat Tonkul completed his PhD in Environmental Science and Engineering at the İzmir Institute of Technology, where his research focused on geothermal systems, CO_2-fluid-rock interactions, critical raw materials, and numerical modelling of geothermal reservoirs. During his doctoral studies, he contributed to the EU Horizon projects REFLECT and CRM-geothermal and worked as a visiting researcher at the Delft University of Technology (TU Delft) in the Netherlands.

Serhat investigated how geothermal fluids interact with reservoir rocks, and how these interactions influence resource sustainability. His work combined field investigations, laboratory analyses, geochemical modelling, and numerical reservoir simulations to better understand the coupled thermal, hydraulic, and geochemical processes operating in high-enthalpy geothermal systems. His work on the characterization of Sb scaling and fluids in saline geothermal power plants of the Germencik Region, Turkey and on the effect of degassing on scaling in the hypersaline system of Tuzla geothermal field, Turkey, have been published already.

Figure 1: During fieldwork in the Tuzla region, Serhat and other CRM-geothermal researchers investigate analogue rocks from geothermal reservoir formations.

Serhat expanded this work towards reservoir-scale numerical modelling. Using advanced thermal-hydraulic and reactive transport simulations, he evaluated the long-term impacts of fluid reinjection and fluid-CO_2 co-injection on reservoir pressure evolution, heat recovery, and geothermal sustainability. His results demonstrate how fluid-rock-CO_2 interactions influence subsurface flow redistribution and reservoir performance over different timescales. For example, Figure 2 shows his results on the expansion of the CO_2 concentration in the geothermal brine during extended injection times. The study is published: Tonkul, S., Erol, S., Baba, A., & Regenspurg, S. (2026). Fluid–CO_2 injection in a hypersaline volcanic systems: a reactive transport and experimental evaluation with application to the Tuzla Geothermal Field, Türkiye. *Geothermal Energy*, *14*(1), 2.

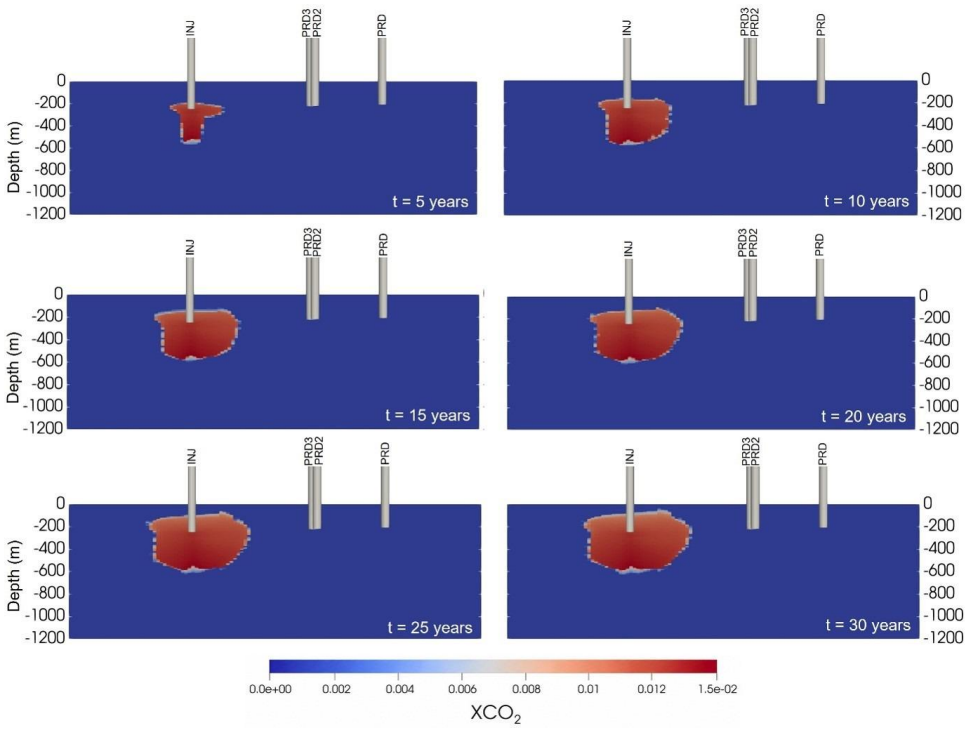


Figure 2: Temporal evolution of CO_2 mole fraction (XCO_2) in the Tuzla geothermal reservoir during 30 years of fluid-CO_2 co-injection, shown at selected time steps. "INJ" marks the injection well, while wells with "PROD" are productions wells.

To support his numerical studies, Serhat conducted a series of CO_2-fluid rock dissolution/precipitation reactions (see Figure 3). He used reservoir rock samples in a batch setup under pressure of up to 4.4 MPa and at temperatures of up to 200 °C. The reservoir fluid coming from Tuzla geothermal field was enriched with CO_2. He observed that CO_2. injection led to the dissolution of feldspar, but also the precipitation of secondary minerals. Both processes would affect the permeability of the reservoir and, consequently, the sustainability of heat and mineral extraction.

Serhat's full thesis is available here.

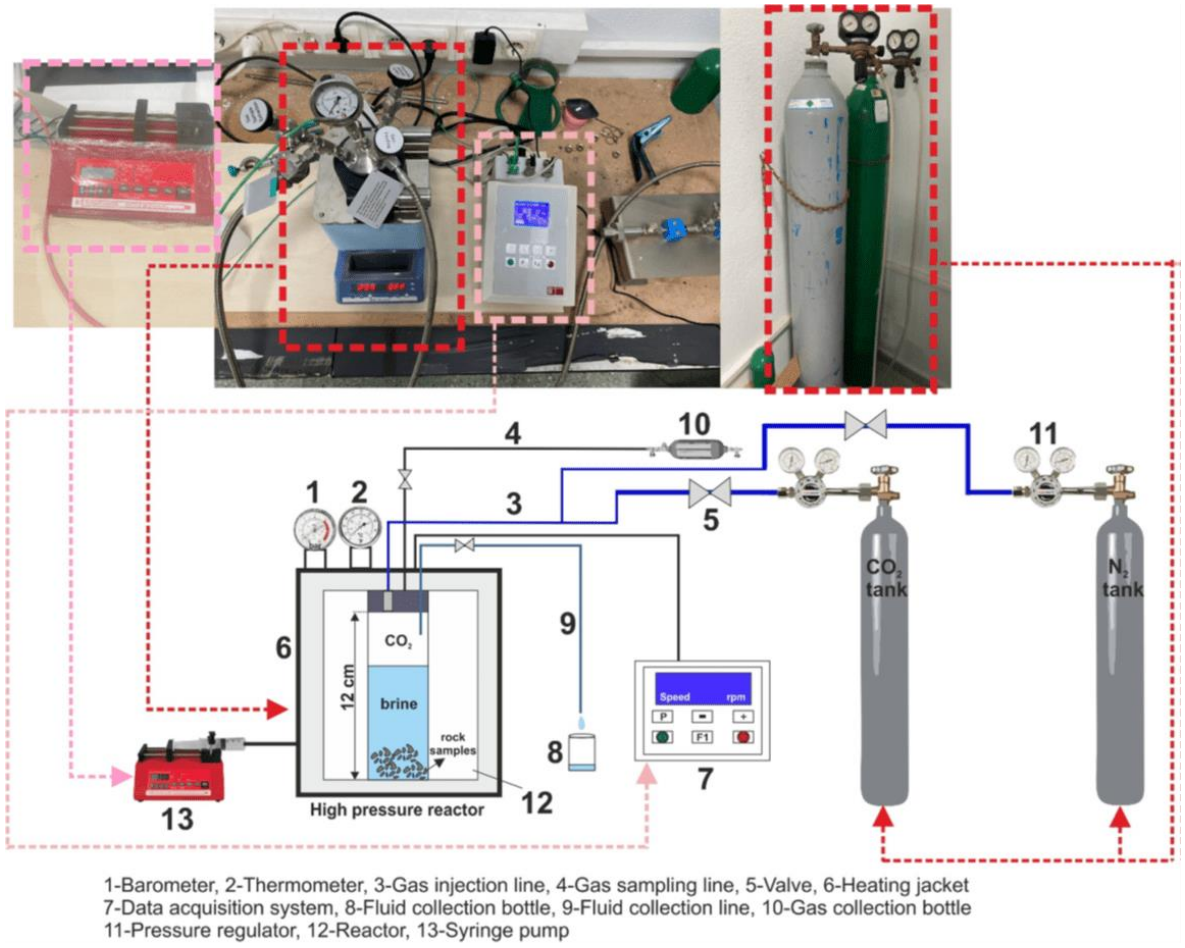


Figure 3: Schematic representation of the batch reactor setup used for the investigation of CO_2-fluid rock dissolution/precipitation reactions.

CRM-geothermal Webinar: Critical Raw Material Extraction Technologies from Geothermal Brines

by crm | Jun 10, 2026 | News | 0 comments

We are pleased to invite you to the webinar **"Technologies for the Extraction of Critical Raw Materials from Geothermal Brines".** This event will bring together leading researchers and experts from the CRM-geothermal project to discuss the development of technologies for the recovery of lithium and other critical raw materials from geothermal fluids. As the demand for critical minerals continues to grow due to the global energy transition and the expansion of battery technologies, geothermal brines are increasingly being recognised as a promising and sustainable resource.

Date: 29 June 2026
Time: 14:00 – 15:30 CEST

New CRM-geothermal factsheet: Fluid Atlas for Geothermal Fluids and Critical Raw Materials

by crm | May 29, 2026 | News | 0 comments

The CRM-geothermal factsheet on the Fluid Atlas has been launched!

The Fluid Atlas is an open-access, web-based mapping platform that brings geothermal, geochemical, and geological data together in a spatially integrated form across Europe and Eastern Africa. Its aim is to make complex information accessible, transparent, and comparable by placing it in a clear geographic context.

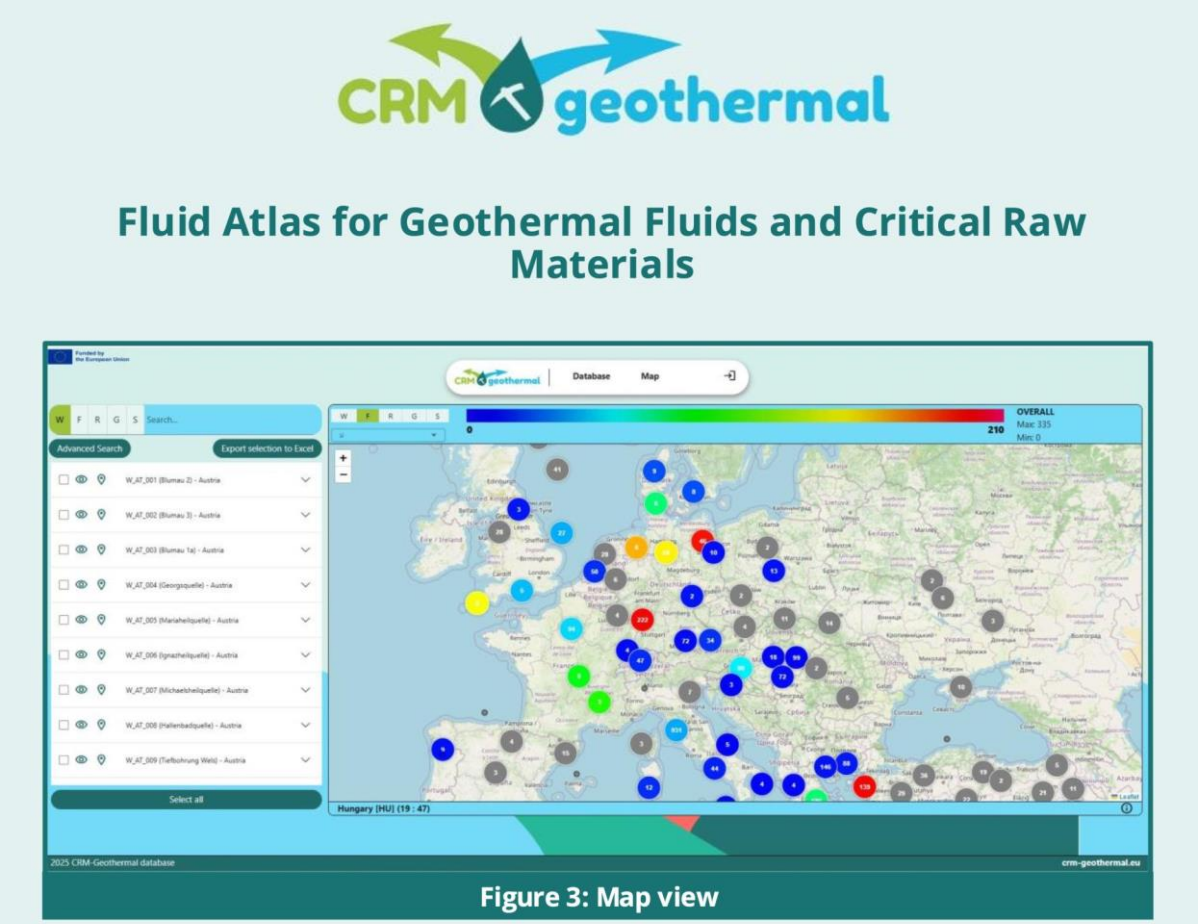


Figure 3: Map view

The platform lets users:– Explore the spatial distribution of geothermal wells and systems– Examine fluid chemistry, gas compositions, rock samples, and mineral scales– Identify regions enriched in elements critical for modern technologies– Compare geothermal fluids across volcanic regions, sedimentary basins, and rift-related systems– Download harmonised, georeferenced datasets (no registration required).

It is built entirely on open-source components (MySQL, Leaflet, open formats like JSON and GeoJSON) and follows FAIR data principles, ensuring datasets are findable, accessible, interoperable, and reusable. No commercial software, paid APIs, or subscriptions are needed to access or operate the platform. Beyond research, the Atlas supports early-stage resource evaluation, education and training, and evidence-based decision-making on the potential of geothermal fluids as sources of critical raw materials.

📄 Read the factsheet to learn more about the Fluid Atlas: https://crm-geothermal.eu/go/factsheet-fluid-atlas

Student Stories – Seyra Toprak: Recovery of lithium from high-salinity geothermal brines using selective adsorption technologies

by crm | Mar 30, 2026 | News | 0 comments

Seyra Toprak joined the CRM-geothermal project during her Master's studies, where she focused on the recovery of critical raw materials, specifically lithium, from high-salinity geothermal brines using selective adsorption technologies.

Seyra is currently a PhD student at the İzmir Institute of Technology (İYTE) in the Department of Materials Science and Engineering. Her research contributes to the development of sustainable extraction methods for lithium (Li) from geothermal resources in Turkey, specifically at the Tuzla Geothermal Power Plant (TGPP). The main objectives are to evaluate the efficiency of commercially available sorbents, specifically two varieties of Manganese dioxide (γ-MnO_2 and λ-MnO_2), in real-world conditions and to demonstrate a practical pathway for concentrating lithium into a solid precursor (Figure 1).

The approach adopted in her research combines laboratory-scale batch experiments, on-site field tests at the power plant's reinjection line, and precipitation and purification steps.

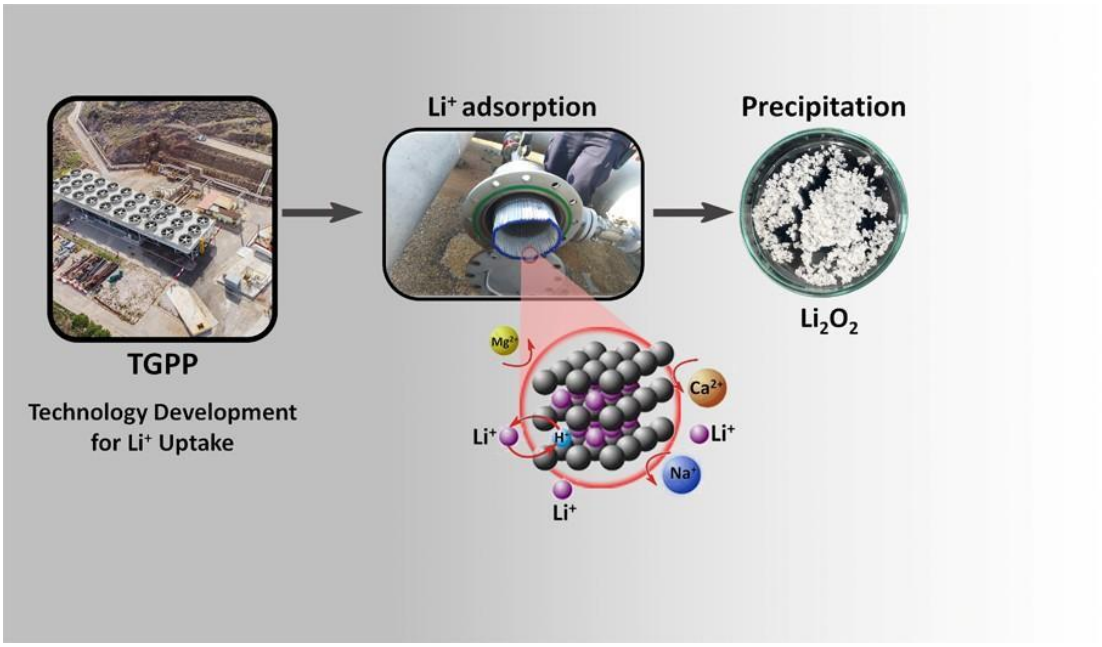


Figure 1*: Graphical summary of the suggested adsorption technique with Manganese dioxide, which is tested during Seyra Toprak's work at the Tuzla Geothermal Power Plant.*

The field adsorption tests were conducted at the Tuzla Geothermal Power Plant, where the acid-treated sorbent was exposed to a continuous geothermal brine flow at a rate of approximately 30 m^3/h. The brine at the site contains a lithium concentration of about 20-25 ppm. Figure 2 illustrates the cumulative enrichment process, where lithium was successfully desorbed and concentrated over multiple successive cycles.

Following the enrichment stage, carbonate-based agents—specifically sodium bicarbonate, sodium carbonate, and ammonium carbonate— were used to selectively remove coexisting ions like Manganese and Calcium without significantly affecting lithium retention. The purification process ensured that the final solution was sufficiently concentrated for the recovery of a solid lithium product.

A key outcome of this work, recently published in ACS Sustainable Resource Management, is the first experimental demonstration of direct lithium peroxide (Li_2O_2) precipitation from geothermal brine. By applying rotary evaporation, a lithium-rich solid with an estimated purity of ~93 wt% was obtained. (Figure 3)

The outcomes of Seyra's study suggest that geothermal brines in the Tuzla region are a viable and strategic source for lithium recovery, providing a versatile precursor that can be converted into battery-grade materials like lithium hydroxide and lithium carbonate. These results highlight the potential of geothermal brines as a source of lithium.

Seyra Toprak conducted this research under the supervision of Prof. Dr. Mustafa M. Demir (İzmir Institute of Technology).

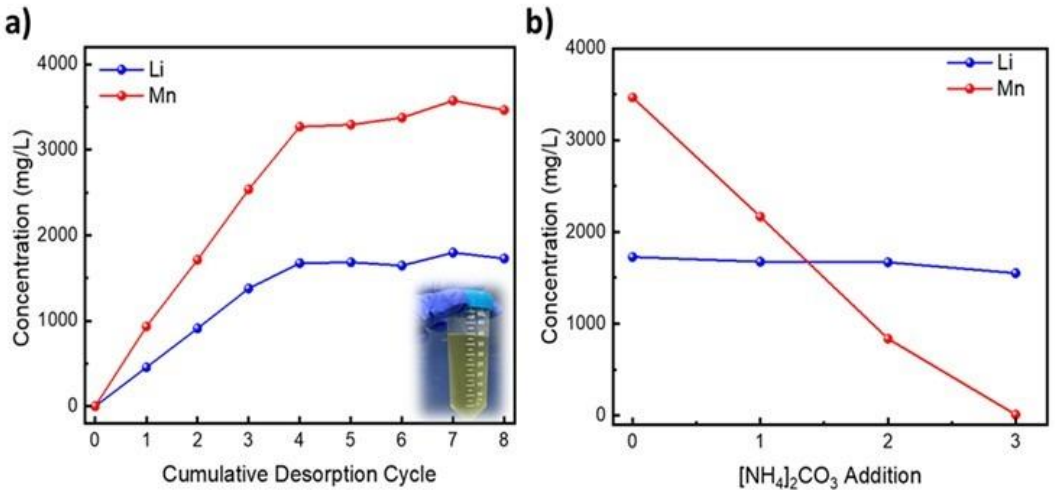


***Figure 2**: (a) Enrichment of lithium concentration with repetitive desorption (8 cycles), the inset of the figure shows a representative photograph of a desorption solution. Yellowish color may due to the formation of $Mn_2Cl_6^{2-}$ complex. (b) Concentration of lithium and manganese after the addition of $(NH_4)_2CO_3$.*

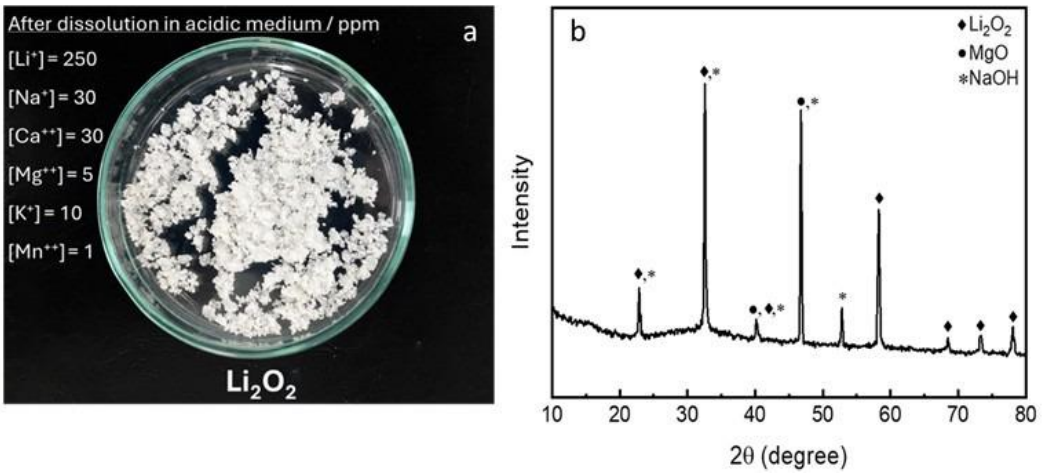
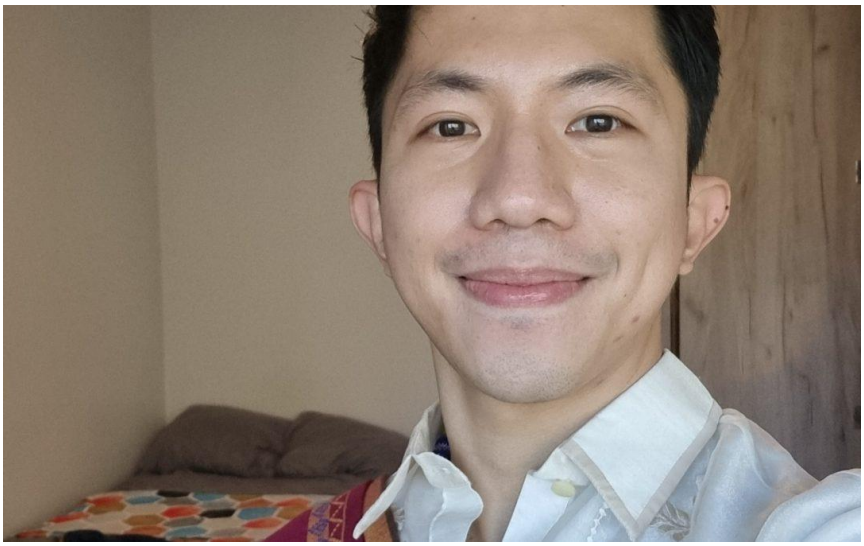


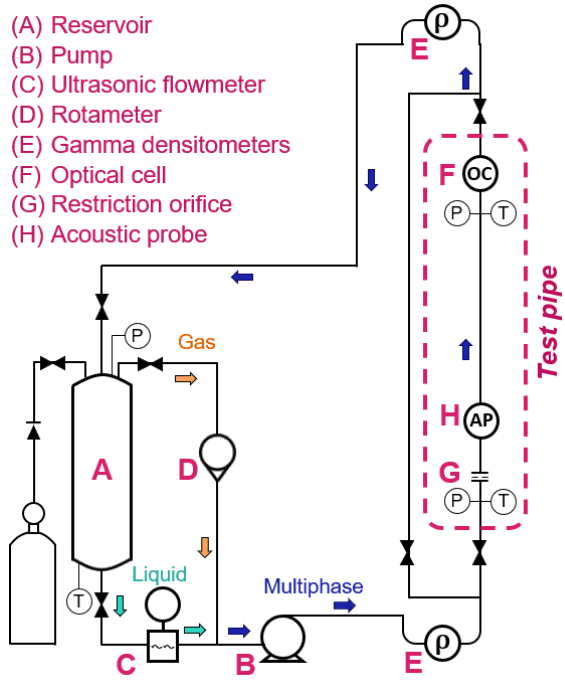
***Figure 3**: Image of the recovered lithium-rich solid obtained after evaporation of the enriched desorption solution (a), XRD pattern of the precipitated powder showing crystalline phase identification (b).*

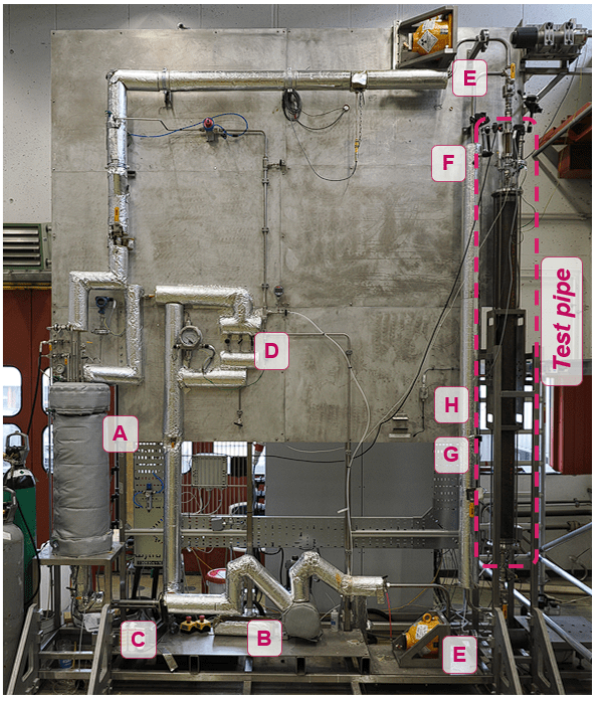
Student Stories – Adolph Jr. Manadao Bravo: Multiphase flow behavior in high-temperature geothermal fluids with a focus on critical raw material recovery

by crm | Mar 25, 2026 | News | 0 comments



Adolph Jr. Manadao Bravo is pursuing his PhD in Earth Sciences at the University of Iceland, where he investigates multiphase flow behavior in high-temperature geothermal fluids with a focus on critical raw material recovery. In his research, he examines how liquid and vapor phases interact under varying pressure, temperature, and salinity conditions, and how these factors influence phase distribution and flow behavior. The interaction between liquid and vapor phases directly affects operational performance in geothermal facilities, particularly pressure losses, flow regime transitions, and mineral deposition. In the context of extracting critical raw materials from geothermal fluids, accurately characterizing these interactions is essential for predicting scaling precipitation along pipelines and wells and refining strategies that support efficient and sustainable resource recovery.





High-temperature geothermal systems naturally contain mixtures of liquid and steam flowing together. This multiphase flow strongly influences how geothermal facilities operate, both underground and at the surface. Despite its importance, most laboratory studies and design tools used in geothermal engineering were originally developed under ambient conditions using oil-gas or air-water systems. Those substitute systems do not truly represent the physical properties and flow behavior of real geothermal fluids. As a result, geoscientist and engineers face uncertainty when applying such tools to operating geothermal fields, which can lead to inaccurate predictions and less efficient production strategies.

Adolph's PhD project aims to address that gap by using the Geothermal Flow-Loop (GFL) at the University of Iceland, a research facility built through the GeoPro project funded by the European Union's Horizon 2020 Research and Innovation Programme. The facility was designed to carry out controlled experiments using geothermal brine at temperatures up to 200 °C and pressures up to 40 bar. The GeoPro project has now concluded, but the facility continues to support advanced geothermal research.

Through the CRM-Geothermal project under Horizon Europe, Adolph used the GFL to collect data across a wide range of temperatures relevant to geothermal operations. By closely reproducing conditions found in real geothermal fields, the GFL provides reliable and practical insights into how liquid and gas phases move together. The aim of the project is to develop models that predict the movement of the gas phase through the liquid, identify the flow regimes that occur, and determine how these behaviors influence mineral deposition along wells and pipelines.

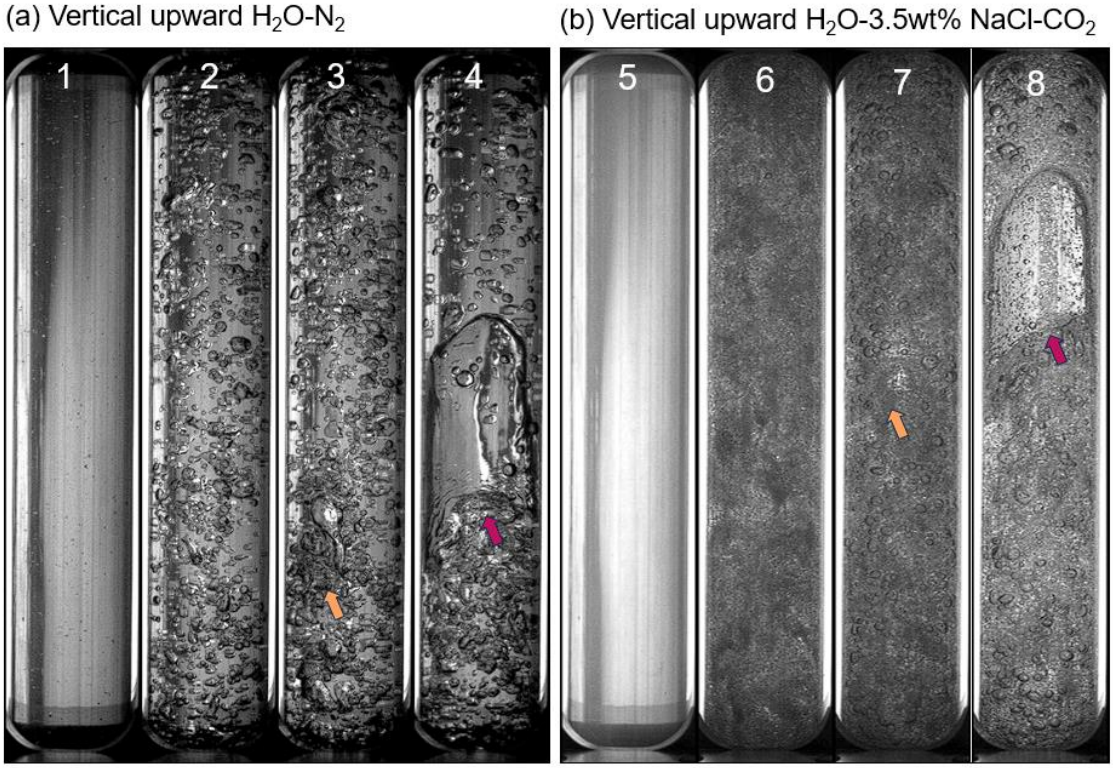


Figure: Evolution of flow regime in vertical flow at 140 °C for (a) water-N2 and (b) water-NaCl-N2. The orange arrows indicate the start of bubble coalescence, while the red arrow indicates the formation of fully developed Taylor bubbles (plugs).

Adolph has already published parts of his results in Geothermics, demonstrating the Geothermal Flow Loop's ability to conduct reliable and field-relevant experiments under geothermal conditions. His ongoing analyses of the collected data, which will be detailed in upcoming publications, show that both temperature and salinity have a significant impact on multiphase flow behavior and the development of different flow regimes. These findings provide important insights for predicting flow patterns and managing mineral deposition in geothermal operations.

Advancing Critical Raw Material Co-Production from Geothermal Fluids: CRM-geothermal Final Conference at GeoTHERM

by crm | Mar 10, 2026 | Uncategorized | 0 comments

The final conference of the EU-funded CRM-geothermal took place on 25 February 2026 in Offenburg, Germany, as an official side event of GeoTHERM. The event brought together more than 50 researchers and industry representatives to reflect on the project's results and the broader prospects of co-extracting critical raw materials (CRMs) from geothermal fluids.

Photo credit: Anita Stein.

Across Europe and beyond, geothermal brines are increasingly being explored not only as a renewable heat source but also as a potential resource for lithium, helium, strontium, and other materials that are critical for the energy transition. Yet CRM occurrence is highly site-specific, and the economic feasibility of combined heat and mineral production has so far remained uncertain. CRM-geothermal is addressing this challenge through a holistic approach covering Europe and East Africa. The project established a comprehensive database and fluid atlas, investigated the geological origin and mobilisation of CRMs in different settings — from fractured crystalline rocks to deep sedimentary basins and volcanic systems — and developed innovative extraction technologies for selected raw materials. Economic, environmental and social dimensions were also assessed, with feasibility demonstrated at a pilot site in Cornwall.

The conference programme reflected this broad scope. Presentations explored CRM content and mobility in geothermal systems in Cornwall, Western Anatolia and the East African Rift, alongside AI-based methods for assessing lithium potential and microbiological processes affecting geothermal wells. Extraction technologies were discussed in depth, including adsorption techniques, biosorption approaches and helium recovery potential, as well as laboratory and mini-plant scale lithium extraction systems. A final session addressed economic and governance aspects, including the application of the UNFC classification framework to combined heat and mineral projects and the steps required to support geothermal lithium production.

Discussions made clear that while technological progress is significant, several hurdles remain before large-scale deployment can be realised. Technical optimisation under real operating conditions, improved operational credibility and greater transparency on capital expenditure are

essential to strengthen investor confidence. Participants also emphasised that projects are not yet sufficiently mature for major financial instruments and that durable, industry-aligned policy frameworks will be crucial to enable “Made in Europe” lithium production. Emerging industrial initiatives lead by Vulcan Energy, Lithium de France, Eramet and Cornish Lithium were highlighted as important signals for the market, provided supportive policy conditions are maintained.

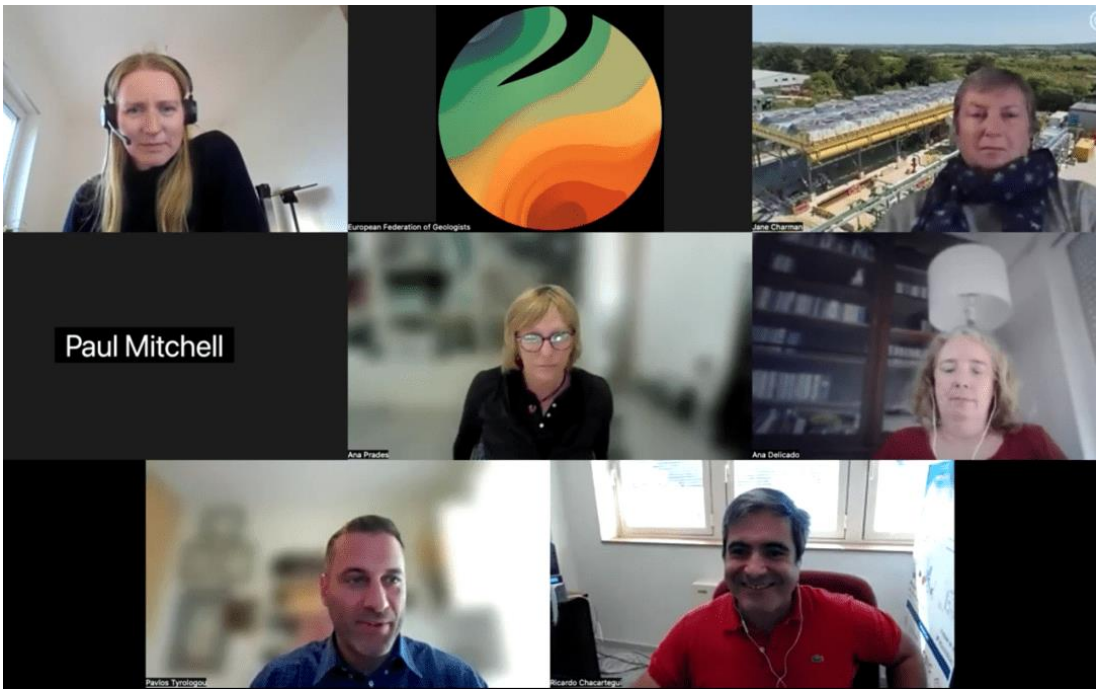
In addition, project coordinators Simona Regenspurg and Katrin Kieling from GFZ presented project results within the main scientific programme of GeoTHERM, further underlining the growing strategic relevance of CRM co-production in the geothermal sector.

The CRM-geothermal project is still running until January 2027. Final results will be disclosed in the coming months.

Please find a selection of pictures from the Final Event below (Photo credits: Tamás Miklovicz):

Watch the Recording: Joint CRM-geothermal & CEEGS Webinar on Social Acceptance!

by crm | Nov 28, 2025 | Uncategorized | 0 comments



Did you miss our joint webinar on social acceptance and community engagement in innovative geothermal and energy-storage technologies? The recording is now available!

Organised by the **CRM-geothermal** and **CEEGS** projects, this session explored the critical role of **social licence to operate (SLO)**, effective **community engagement**, and the social dimensions of emerging technologies that support the energy transition.

📎 **Watch the webinar recording:**

https://tinyurl.com/crm-slo-recording

Featured Speakers

🔹 Moderator: **Pavlos Tyrologou** – Chair of the Advisory Board & Board Projects Advisor, European Federation of Geologists

🔹 **Paul Mitchell** Minerals engineer and ESG specialist with nearly 40 years of global experience across the extractive industries. His work spans mining, metals, rare earths, gemstones and energy minerals, advising companies, regulators, communities and civil society on environmental, social and governance challenges throughout the extractives lifecycle.

🔹 **Jane Charman – Geothermal Engineering Ltd (GEL)** With GEL since 2018, Jane has been involved in all stages of the United Downs geothermal power project. She brings hands-on insight into stakeholder communication, from government to local communities, and is a strong advocate for extracting critical raw materials from geothermal fluids.

🔹 **Dr. Katrin Kieling – CRM-geothermal Project Manager (GFZ Potsdam)** A geophysicist with extensive experience managing EU-funded geothermal projects, including GEMex, REFLECT, and currently CRM-geothermal. Her work focuses on combined extraction of heat and critical raw materials, as well as aquifer thermal energy storage systems.

🔹 **Dr. Ana Delicado – Institute of Social Sciences, University of Lisbon** Senior Research Fellow specialising in social studies of science. Ana has led national and EU projects on renewable energy acceptance, CCS, science communication, and disaster risk reduction. She also coordinates the Observatory of Changing Society and teaches in the PhD programme on Climate Change and Sustainable Development Policies.

🔹 **Prof. Ricardo Chacartegui – University of Seville / CEEGS Coordinator** Professor of Energy Engineering with more than 150 indexed publications and extensive research in energy storage, low-carbon energy systems and innovative technologies. He coordinates the Horizon Europe **CEEGS** project on transcritical CO_2 energy storage.

🔹 **Dr. Ana Prades – CIEMAT / CISOT-CIEMAT** Senior scientist and head of CISOT-CIEMAT, specialising in social perception of environmental and technological risks and citizen participation for sustainability. Ana has coordinated several EU-funded projects, including the Social Studies on Fusion programme and currently the H2020 **ECF4CLIM** project on climate competences in education.

Don’t miss the project conference ‘Navigating the Energy Transition’ at the European Parliament

by crm | Nov 6, 2025 | News | 0 comments

Spotlight on Innovation: Research Breakthroughs from CRM-geothermal

Europe’s journey to climate neutrality by 2050 depends on securing the materials that power the green transition. The **Critical Raw Materials Act (CRMA)**, adopted in 2024, lays the foundation for Europe’s strategic autonomy, ensuring reliable access to essential resources for renewable energy technologies, energy storage, and electrification.

Yet, beyond securing supply chains, the CRMA must also deliver **affordable energy**, **public trust**, and **local benefits**. Many communities see extraction projects as conflicting with their well-being, while high energy prices continue to affect households across Europe. The challenge is clear: how can Europe align resource extraction with social equity, environmental protection, and cost-effective clean power?

This in-person session at the European Parliament will spotlight **research and innovation breakthroughs from the CRM-geothermal project,** an EU-funded initiative exploring how **critical raw materials (CRMs)** can be extracted sustainably from **geothermal fluids**, linking renewable energy generation with responsible resource recovery.

By coupling geothermal energy production with CRM extraction, this approach offers a model for **reducing costs**, **cutting emissions**, and **creating shared value** across Europe’s regions.

Date & Venue: European Parliament, Brussels
Format: In-person

Registration:

https://ec.europa.eu/eusurvey/runner/crm-geothermal-ep

Agenda:

12:00 – 12:05 Welcome: *MEP Nicolás González Casares* – S&D

12:05 – 12:20 Keynote (TBC): *MEP Davor Ivo Stier* – EPP

12:20 – 12:35 Keynote Presentation: *"Critical Raw Materials and Renewable Energy: Building the Foundations for Affordable Clean Power in Europe" Simona Regenspurg* – GFZ Helmholtz-Centre for Geosciences

12:35 – 13:20 Panel Discussion: *Harnessing Innovation to Secure Raw Materials and Power the Energy Transition* This discussion will explore how integrating CRM extraction with renewable energy production can strengthen Europe's clean energy capacity, enhance supply security, and lower costs—while ensuring that the CRMA's implementation remains fair and inclusive.

Panellists:

- *Christine Banken*, European Commission, DG Energy
- *Mark Harris*, Cornish Lithium
- *Simona Regenspurg*, GFZ Helmholtz-Centre for Geosciences
- *Kestutis Kupsys*, European Economic and Social Committee (2020-25), consumer rights activist
- *Emily Ritchey*, Transport & Environment (T&E)
- *Panel moderator: Pavlos Tyrologou*, European Federation of Geologists

13:20 – 13:30 Closing Remarks: *MEP Nicolás González Casares "Making the Energy Transition Affordable and Inclusive for All Europeans"*

Event moderation: *Katrin Kieling*, GFZ Helmholtz-Centre for Geosciences

Why Attend?

- Discover how CRM-geothermal innovations link **resource extraction and renewable energy** for a circular, low-carbon economy.
- Engage with **policymakers, industry leaders, researchers, and civil society** on the next steps for CRMA implementation.
- Explore **new business and social models** that make Europe's energy transition both **affordable and inclusive**.

CRM-geothermal Final Conference at GeoTHERM 2026 in Offenburg

by crm | Oct 31, 2025 | News | 0 comments

The **CRM-Geothermal Final Conference** is taking place **in person** on **25 February 2026**, from **13:00 to 17:00 CET** in **Offenburg, Germany**, organised in cooperation with **GeoTHERM 2026: https://www.geotherm-offenburg.de/en**

Participation is free and does **not require a GeoTHERM event badge**.

The conference is scheduled **one day before GeoTHERM (26–27 February 2026)** and concludes in time for participants to join the traditional **GeoTHERM Ice-Breaker at 18:30 on 25 February 2026**. Please note that participation in the Ice-Breaker is **not included** with registration for the CRM-Geothermal Final Conference.

This final project conference will showcase the main findings of the **EU-funded CRM-geothermal project**, with presentations by consortium partners and invited experts.

AGENDA

13:00-13:05	CRM Geothermal – Critical raw materials in geothermal fluids	Simona Regenspurg (GFZ)

Session 1: *Content, origin, and mobility of Critical Raw Materials (CRM) in geothermal fluids across different geological settings*

13:05-13:20	Geothermal fluids in fractured crystalline	**Christopher Rochelle** (British Geological Service, BGS)

	formations in Cornwall and their suitability for sustained CRM production. (tbc)	
13:20-13:35	CRM-geothermal Data Publication & Fluid Atlas	Éva Hartai, **Anna Seres,** Martin Szabó, Tamás Madarász, (University of Miskolc), János Szanyi (University of Szeged)
13:35-13:50	AI-Enhanced Assessment of Lithium Potential in Geothermal Reservoirs Using Explainable Decision Tree Models	**Konstantinos Loupos** (INLECOM Innovation)
13:50-14:05	Origin of Critical Raw Minerals (CRM) In A Metamorphosed Flysch and Volcanic System of the Geothermal Area in Western Anatolia, Türkiye	**Alper Baba**, Tolga Ayzit (Izmir Institute of Technology), et al.
14:05-14:20	Assessment of co-production of Geothermal Energy and Critical Raw Materials in the East African Rift	**Franziska Wilke** (GFZ), Kondwani Gondwe (Mzuzu University), Anna Jentsch (GFZ), Eugene Karangwa (University of Rwanda), Katrin Kieling (GFZ), Lukas Klose (Constructor University), Timmu Kreitsmann (Constructor University), Albano Mahecho (Tanzania Geothermal Development Company), Samuel Niedermann (GFZ), Leon Ntihabose (EWSA), Lydia Olaka (Technical University of Kenia), Simona Regenpurg (GFZ), Jessica Stammeier (GFZ), Bettina Strauch (GFZ), Martin Zimmer (GFZ)
14:20-14:35	Bacterial and fungal diversity in two geothermal wells showing sulphur-sulphide production in Cornwall (UK)	Danae Bregnard (University of Neuchâtel), Maude Rochaix (University of Neuchâtel), Adam Matthews (Cornish Lithium); Allistair Salisbury (Cornish Lithium); Benoit Valley (University of Neuchâtel); Guillaume Cailleau (University of Neuchâtel), Mark Harris (Cornish Lithium); **Pilar E. Junier** (University of Neuchâtel); Saskia Bindschedler (University of Neuchâtel); Sean Cleveland (Cornish Lithium); Simona Regenspurg (GFZ); Zoe Carter (Cornish Lithium)

Coffee break

Session 2: *Extraction methods for CRM from geothermal fluids*

14:55-15:10	Lithium extraction from saline geothermal fluids: is there an ideal sorbent?	**Elisabeth Eiche** (Karlsruhe Institute of Technology)
15:10-15:30	Recovery of Li from Geothermal Waters by Adsorption Using MnO2 Polymorphs as Sorbent Material	**Jörg Zotzmann** (GFZ), **Mustafa M. Demir** (Izmir Institute of Technology), Seyra Toprak (Izmir Institute of Technology)
15:30-15:42	Biosorption of lithium from geothermal waters with the help of bacteria	**Florian H. H. Brill**, Tilman Gehrke (Dr. Brill + Partner GmbH Institut für Hygiene und Mikrobiologie)
15:43-15:55	Low Molecular Weight Organic Acid Analysis for the Characterisation of a Biorecovery System to Recuperate Critical Raw Materials in Geothermal Systems	**Guylian Laurent** (University of Neuchâtel), Mike C. Rowley (University of Zurich), Guido L. B. Wiesenberg (University of Zurich), Pilar Junier (University of Neuchâtel), Saskia Bindschedler(University of Neuchâtel)
15:55-16:10	The Potential of Helium Production from Geothermal Fluids	**Bettina Strauch** (GFZ), Martin Zimmer (GFZ)
16:10-16:25	Extraction of lithium in fixed-bed columns and mini-plant: laboratory, modelling and experimental setup	**Stefan Kranz** (GFZ), Karen Silgado (GFZ)

Session 3: *Economic, social, and governance aspects of CRM co-production*

16:25-16:45	First steps towards supporting Lithium production from geothermal fluids (tbc)	**Karen Wagner Weise, Xochitl Dominguez** (Equinor)
16:45-17:00	Joint resource calculation according to the UNFC in the case of complex geothermal energy utilisation	Tamás Madarász (University of Miskolc), Christopher Rochelle (BGS), **János Szanyi** (University of Szeged), Vitor Correia (INTRAW), Eberhard Falck (INTRAW), Anna Seres (University of Miskolc).
17:00-17:15	Applying the UNFC classification to projects of combined extraction of heat and minerals	**W. Eberhard Falck**, Vitor Correia (INTRAW International Raw Materials Observatory)

Closing remarks

ABOUT THE CRM-GEOTHERMAL PROJECT

The **CRM-geothermal project** applies a holistic approach to evaluating and extracting **Critical Raw Materials (CRM)** from geothermal fluids in **Europe and East Africa**. Its work bridges geoscience, technology, and sustainability to strengthen Europe's raw materials independence.

Key project achievements include:

-1. Assessment of CRM potential: A comprehensive database and a **Fluid Atlas** were developed to visualise the distribution of critical raw materials in geothermal fluids.

-2. Understanding geological processes: The **origin and mobilisation of CRMs** were studied across diverse geological settings – such as crystalline fractured rocks and deep sedimentary basins with high-salinity fluids – to assess their occurrence and long-term extraction potential.

-3. Innovative extraction technologies: New methods were developed for extracting CRMs such as **lithium, strontium, and helium** from different types of geothermal fluids.

-4. Socio-economic and environmental assessment: The project evaluated **economic, social, and environmental dimensions** of CRM co-production.

-5. Demonstration of feasibility: The **co-extraction of CRMs** was successfully demonstrated at a **pilot site in Cornwall (UK)**.

JOIN THE FINAL CONFERENCE

The registration for the conference is closed.

CRM-geothermal & CEEGS Webinar: Social acceptance for innovative technologies in the energy transition

by crm | Sep 24, 2025 | News | 0 comments

We are pleased to invite you to a joint webinar on social acceptance topics, organised by the CRM-geothermal and CEEGS projects. This insightful session will delve into the critical aspects of social license to operate (SLO) and community engagement within the context of innovative technologies boosting the energy transition.

JOIN THE WEBINAR!

This event will feature expert presentations on social acceptance guidelines, best practices for community engagement, and the latest social acceptability studies from both projects. It is an invaluable opportunity for researchers, policymakers, industry professionals, and stakeholders interested in fostering positive relationships between geothermal initiatives and local communities.

Date: 23 October 2025
Time: 14:00 – 15:30 CEST
Register here: https://tinyurl.com/webinar-r-crmceegs

AGENDA:
14:00 – Welcome and short introduction to CRM-geothermal
Speaker: Katrin Kieling, GFZ

14:15 – Presentation of SLO Guidelines
Speaker: Paul Mitchell, Levin Sources

14:30 – Community engagement best practices
Speaker: Jane Charman, GEL

14:45 – Short introduction to CEEGS
Speaker: Ricardo Chacartegui, University of Sevilla

15:00 – Social acceptability studies in CEEGS
Speakers: Ana Delicado, University of Lisbon / Ana Prades, CIEMAT

15:15 – Q&A

15:30 – End of event

SPEAKERS:

- **Paul Mitchell** originally trained as a minerals engineer, and after completing his doctorate on the control of pollution emanating from metal mine wastes, focused on the environmental, social and governance (ESG) aspects of extractives, with a particular focus on mining. For nearly 40 years, he has worked on projects related to a broad range of mineral and metal commodities, including potash, base and precious metals, minor metals, industrial minerals, coal and other energy minerals, aggregates, strategic metals, rare earth elements and gemstones. He has a detailed understanding of different regulatory and legislative regimes across the extractive industries lifecycle (from exploration to closure) and has worked on extractives projects in the Middle East, the Americas, Africa, the Caribbean, Europe, Asia and Oceania. Paul's extensive experience informs his understanding of mining-related technical, environmental, social and governance challenges and opportunities. His experience includes mining at all scales, from artisanal to large-scale industrial operations across the project lifecycle, working with diverse clients including mining, smelting and refining companies, trade associations, communities and civil society stakeholders, regulators and legal experts to design and implement appropriate solutions to ESG issues.
- **Jane Charman** has worked for GEL since 2018, so has experienced every stage of the geothermal power project at the United Downs site. This has given Jane the ability to talk to all stakeholders from government ministers to the local community about the technical aspects of deep geothermal projects. GEL has also worked with schools, colleges and universities giving talks, lessons and careers information for many years. Jane is a huge advocate of extracting critical raw materials from geothermal fluid and is excited to share information about the progress the UK is making as well as other project partners.
- **Katrin Kieling** is the project manager of the CRM-geothermal project. She is a geophysicist by education. After obtaining her doctoral degree from the University of Potsdam (Germany), Katrin switched to research management and completed a trainee programme at the project office of the Helmholtz-Centre for Geosciences in 2015. In 2016, Katrin joined the Geothermal Energy section of GFZ. Since then, she has managed EU-funded projects on topics related to geothermal systems, starting with the GEMex collaboration with Mexico and continuing with the REFLECT project on geothermal fluids. Currently, she focuses on the combined extraction of heat and CRM from geothermal fluids in CRM-geothermal as well as on aquifer thermal energy storage in the projects GeoSpeicherBerlin and PUSH-IT.
- **Ana Delicado** is a Senior Research Fellow at the Institute of Social Sciences (ICS) of the University of Lisbon and has a PhD in Sociology (2006). She specialises in social studies of science. She is currently coordinator of the Observatory of Changing Society of ICS. She has coordinated competitively funded national projects on scientific associations, the acceptance of renewable energies and social dimensions of the Internet of Things. She has led the ICS team in six EU-funded research projects on children and disaster risk reduction, renewable energy landscapes, science communication, CCS and CEEGS. She teaches in the PhD programme on Climate Change and Sustainable Development Policies and frequently engages in science outreach.
- **Ricardo Chacartegui** is a professor at the Energy Engineering Department of the University of Seville. He obtained his PhD in 2005, and since 2006, he has more than 150 documents

registered in Scopus and more than 80 publications in international congresses since 2007. His main research fields are related to energy storage, novel energy systems, and LCE technologies. He has participated in more than 60 projects in collaboration with the industry and he has participated in 9 patents. Ricardo coordinates the Horizon Europe project for energy storage CEEGS, based on transcritical CO2 energy storage.

- **Ana Prades** holds a degree in Political Science and Sociology and a PhD in Information Science, both from the Complutense University of Madrid. She is a senior scientist at CIEMAT (a public research body specialising in energy, technology and the environment) and heads the Sociotechnical Research Centre (CISOT-CIEMAT) in Barcelona. Her research focuses on the social perception of environmental and technological risk, as well as on tools and methods for citizen participation in the context of climate change and sustainability. Another of her areas of research is the implications of these processes for the development and implementation of public policies. Ana coordinated the PACHEBEL project, funded by the European Union's 7th Framework Programme (2010–2013), and the Social Studies on Fusion (SES) programme (2014–2020). She is currently coordinating the ECF4CLIM project, funded by H2020, which focuses on developing a European competence framework to combat climate change and promote sustainability in education (2021–2025).

We look forward to your participation in this important conversation about building trust and acceptance around technologies boosting the energy transition.

'Invisible Mining in Action' Bootcamp at Vulcan Energy Facilities

by crm | Sep 9, 2025 | News

As part of the EU-funded CRM-geothermal project, an innovation bootcamp for policymakers, operators, and mining professionals was organised at Vulcan Energy Resources' sites in Insheim and Landau (Germany) on 8 September 2025.

The event was co-organised by CRM-geothermal project partners Vulcan Energy Resources, the European Federation of Geologists (EFG), GFZ Helmholtz Centre for Geosciences, and INTRAW.

The event, titled '**Invisible Mining in Action**', combined presentations with guided visits to geothermal and lithium facilities, giving participants a first-hand view of how zero-carbon lithium can be produced from geothermal brine.

On the bus to Insheim, participants were introduced to the broader project and to the industrial and geological context of the Upper Rhine Valley:

- Project coordinator **Katrin Kieling** provided an overview of the CRM-geothermal project and its research performed in the field of combined energy/mineral extraction.
- **Reza Toufighi** from Vulcan introduced the Phase 1 Lionheart zero-carbon project, which adapts commercially proven technology to produce battery-grade lithium from geothermal brine: https://v-er.eu/phase-one-lionheart.
- **Christoph Hilgers** from BDG, EFG National Association from Germany and an Affiliated Entity of the project, introduced the geology of the Upper Rhine Valley and explained what makes it so appropriate for the combined extraction technology.

The 'Invisible Mining in Action' bootcamp featured several site visits where participants experienced geothermal energy and lithium extraction technologies in practice:

- Geothermal power plant, Insheim: Guided by Jijo Thunduvila Johnson (Vulcan), showing how renewable power is supplied to nearly 9,000 households (more here).
- Lithium Extraction Optimisation Plant (LEOP), Landau: With Thomas Aicher and Jean-Baptiste Bertin (both from Vulcan) explaining the step-by-step process of lithium extraction from geothermal brine (details here).
- VERCANA V-20 drilling rig, Insheim: Where participants observed the latest drilling operations (see more).

Vulcan Energy Resources is one of the Strategic Projects under the EU's Critical Raw Materials Act, with the potential to make a significant contribution to Europe's raw material security. Thanks to the high salinity of geothermal brine, around one gram of lithium can be produced per litre, a unique opportunity to supply battery-grade lithium sustainably and at scale.

CRM-geothermal thanks all the participants for their interest in our project and expresses a particular thanks to MEP Jens Geier, Federica Miccoli (European Commission) and Dumitru Fornea (European Economic and Social Committee) who could accommodate the event in their busy policy agendas.

Special thanks go to Vulcan Energy Resources for hosting the "Invisible Mining in Action" bootcamp and showcasing their pioneering work.

Stay tuned for more updates on CRM-geothermal activities!

CRM-geothermal Webinar: Unlocking the Power of AI in Lithium Exploration

by crm | Aug 7, 2025 | News | 0 comments

We are excited to invite you to a webinar to present the **Lithium Estimation AI Tool**, developed by project partner INLECOM as part of the EU-funded CRM-geothermal project. This innovative AI-driven solution is poised to transform how we explore lithium within geothermal resources – at a time when lithium's role in battery technologies and renewable energy systems has never been more critical.

Join the Webinar!

This webinar will explore the underlying technologies, practical applications, and strategic value of the CRM-geothermal Lithium Estimation AI Tool. It's a must-attend for geoscientists, exploration companies, policymakers, and anyone interested in the future of sustainable lithium sourcing.

Date: 18 September 2025
Time: 14:00 – 15:00 CEST
Register here: https://tinyurl.com/crm-webinar1

About the Tool

The **Lithium Estimation AI Tool** leverages advanced artificial intelligence techniques, particularly tree-based ensemble methods, to identify patterns and dependencies in large, complex geothermal datasets. Unlike traditional statistical models, which often rely on rigid assumptions, this AI-based approach captures the true complexity of subsurface systems – where geological, chemical, and thermal processes interact in non-linear and often unpredictable ways.

Why It Matters

The integration of AI offers several transformative benefits:

- **Higher predictive accuracy** in identifying lithium-rich geothermal reservoirs.
- **Scalability and adaptability** to new data, features, or reservoir types.
- **Transparent and explainable predictions**, enabling informed, defensible decisions in regulatory and commercial settings.

Speakers

- **Katrin Kieling** is the project manager of the CRM-geothermal project. She is a geophysicist by education. After obtaining her doctoral degree from the University of Potsdam (Germany), Katrin switched to research management and completed a trainee programme at the project office of the Helmholtz-Centre for Geosciences in 2015. In 2016, Katrin joined the Geothermal Energy section of GFZ. Since then, she has managed EU-funded projects on topics related to geothermal systems, starting with the GEMex collaboration with Mexico and continuing with the REFLECT project on geothermal fluids. Currently, she focuses on the combined extraction of heat and CRM from geothermal fluids in CRM-geothermal as well as on aquifer thermal energy storage in the projects GeoSpeicherBerlin and PUSH-IT.

- **Mr Konstantinos Loupos**, R&D Director (INLECOM INNOVATION), holds an MBA (Hellenic Open University, GR), an M.Sc. in Microelectronics Systems Design (University of Southampton, UK) with distinction, and an M.Eng. in Electronic and Electrical Engineering (University of Manchester, UK). He has extensive experience in embedded systems and sensors and microelectronics systems, security systems, IoT/ICT technologies and Cybersecurity. His research interests and activities range in IoT/ICT systems, Cybersecurity, Sensors and Systems for Structural Health Monitoring (tunnels, structures, bridges, etc.), Robotics for Civil Infrastructure Inspection, Security Systems (sensors and communications), Water Demand Management, Wireless Sensor Networks and Application Specific Embedded Systems. Konstantinos Loupos has actively and successfully participated in a series (more than 40, since 2002) of EC co-funded projects (FP5, FP6, FP7, H2020, HEU, MED, GSRT and other) in the areas of SEC, IST, ICT, SME, NMP, COOP, MED, CBC-MED and TRANSPORT, with significant positions of responsibility (Project Coordinator, Technical Manager, Leader of Development teams etc). He has more than 80 publications in Conference proceedings, Journals and book chapters and 7 EU/US filed patents. He is serving as a formal evaluator (expert) of EC projects in various topics of FP7, H2020, EUKERA/EUROSTARS, MCST, MARTERA, ERANET and MED programmes. Konstantinos Loupos is a certified PMP, SCRUMand GDPR expert (Certified DPO).

He is a member of EUROPOL EC3 cyber security group and the European Cybercrime Center, member of the Secure Platform for Accredited Cybercrime Experts (SPACE), a member in the EUROPOL Data Protection Experts Network (EDEN) and the Alliance for Internet of Things Innovation (AIOTI). Currently, Konstantinos Loupos is involved into several research projects such as: ERATOSTHENES (coordinator), PILOTING (Executive committee), PROFILE (DPO), CRM-GEOTHERMAL, FIREFLY, CONNECTOR, GENESIS, LINGUARIZE-DC, EVOROADS, SMARTIN (AI tasks) and many more.

- **Dr. Stathis Antoniou**, Head of AI research (INLECOM INNOVATION), has led multiple projects in the fields of AI and Mathematical Modelling. He has worked as a lead data scientist/statistician in various companies and has extensive experience in management and implementation of end-to-end machine learning pipelines that align with business KPIs and EU trustworthiness standards. He holds a PhD in Mathematical Modeling (National Technical University of Athens) and a MSc in Machine Learning (Ecole Polytechnique of France). He has multiple research publications and has co-authored patent US20220369534A1 for real-time crop-analysis via neural networks. He is currently contributing to research projects CRM-GEOTHERMAL, LINGUARIZE-DC, EVOROADS, EMERALDS, GEMINI and AI4CCAM.

CRM-Geothermal Researchers Present Breakthroughs at Goldschmidt 2025 in Prague

by crm | Jul 7, 2025 | News | 0 comments

Some of the CRM-geothermal project researchers will be presenting their work at the Goldschmidt Conference, taking place 6–11 July 2025 in Prague.

Don’t miss their presentations:

- Monday 7 July, 17:30-19:30, Poster Hall 2B (2nd floor, Prague Congress Centre) – Poster #253 ‘**Tracing Critical Raw Materials: Using Geothermal Fluids as Subsurface Probes to identify Platinum Group Element (PGE) Distributions**‘ by **Jessica Stammeier** (GFZ Helmholtz Centre for Geosciences): https://conf.goldschmidt.info/goldschmidt/2025/meetingapp.cgi/Paper/30863 You can consult the poster here.

- Tuesday 8 July, 9:30-9:45, Terrace 2B (2nd Floor, Prague Congress Centre) – Presentation ‘**Assessment of co-production of Geothermal Energy and Critical Raw Materials in the East African Rift**‘ by **Franziska Wilke** (GFZ Helmholtz Centre for Geosciences): https://conf.goldschmidt.info/goldschmidt/2025/meetingapp.cgi/Paper/27195

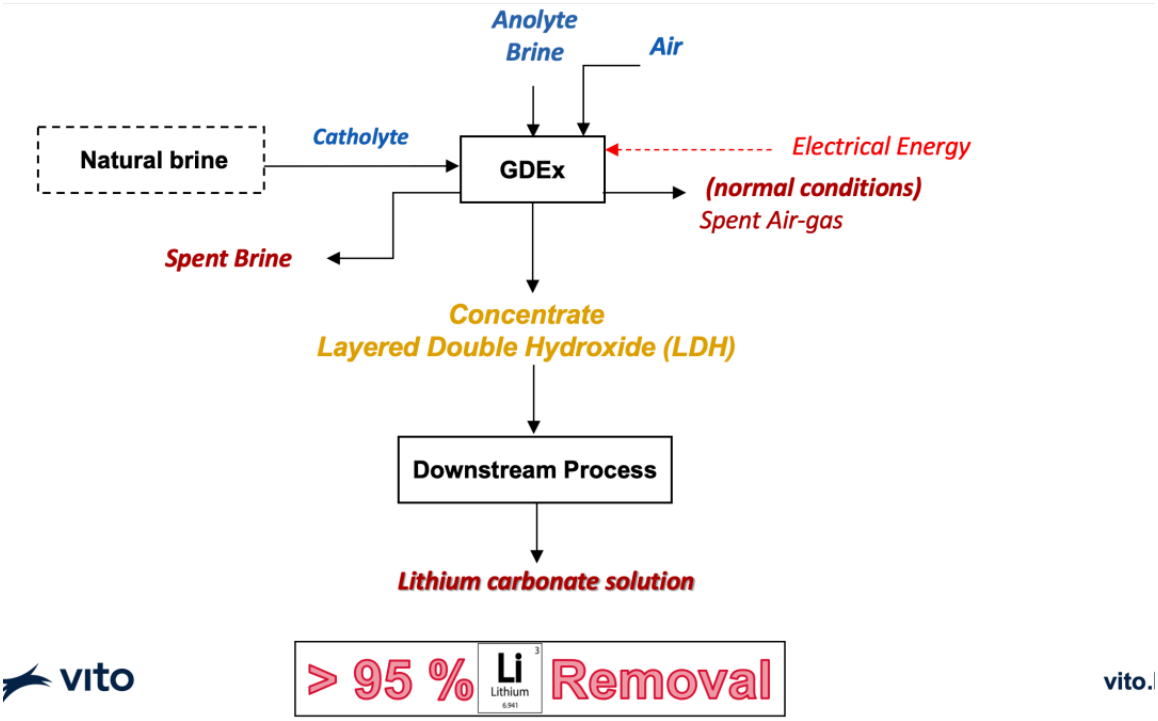
- Thursday 10 July, 17:00-17:15, North Hall (2nd Floor, Prague Congress Centre) – Presentation ‘**Rare Earth Elements in alkaline geothermal fluids from Iceland and the East African Rift, Kenya: A data quality and anomaly assessment via the λ polynomial modelling approach**‘ by **Lukas Klose** (Constructor University): https://conf.goldschmidt.info/goldschmidt/2025/meetingapp.cgi/Paper/31571

- Thursday 10 July, 17:30-19:30, Poster Hall 3A (3rd floor, Prague Congress Centre) – Poster #305 ‘**Extraction of Critical Raw Materials from Geothermal Precipitates from Reykjanes, Iceland**‘ by **Lea M. Krohn** (ETH Zurich): https://conf.goldschmidt.info/goldschmidt/2025/meetingapp.cgi/Paper/26778 You can consult the poster here.

- Friday 11 July, 15:30-15:45, South Hall 3C (3rd Floor, Prague Congress Centre) – Presentation ‘**Lithium content in deep geothermal fluids of the North German Basin and its mobility in different geological formations**‘ by **Simona Regenspurg** (GFZ Helmholtz Centre for Geosciences): https://conf.goldschmidt.info/goldschmidt/2025/meetingapp.cgi/Paper/26994

Milestone Achieved: Advancing GDEx Technology for Sustainable Lithium Extraction

by crm | Mar 26, 2025 | News | 0 comments



The CRM-geothermal Milestone 13 'Definition of elements for which GDEx will be optimised' has been successfully achieved by project partner VITO.

Dr. Ranjith Prasannachandran

Dr. Xochitl Dominguez Benetton

Dr. Savitha Thayumanasundaram

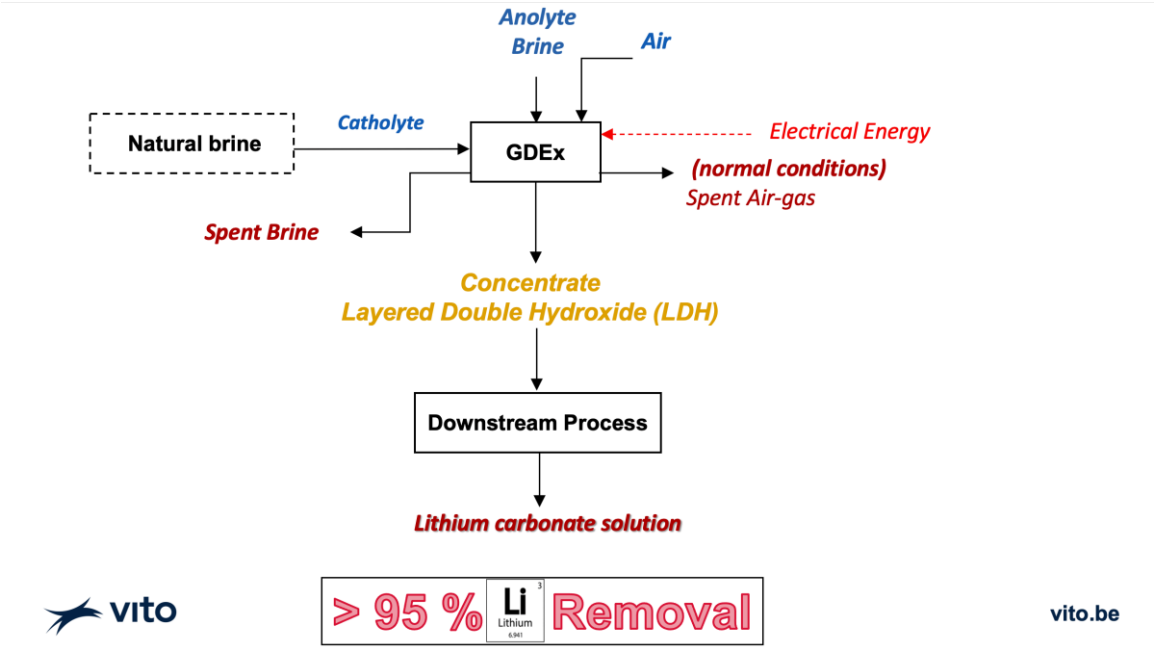
VITO G-DEx Team

In the coming months, the research of the GDEx technology to extract lithium from geothermal fluids and convert it into battery-grade lithium carbonate will continue. Future investigations will explore the technical feasibility of extracting additional elements through a multi-step GDEx process, with each step selectively recovering specific metals.

The GDEx process, based on Gas-Diffusion Electrocrystallisation, represents an innovative approach to extracting Critical Raw Materials (CRMs) by utilising gas-diffusion electrodes to enable precise chemical transformations. This method enhances efficiency while minimising chemical additives, making it both effective and environmentally friendly. Its flexible and scalable design allows for the controlled synthesis of targeted materials, positioning GDEx as a promising solution for industrial-scale lithium extraction and sustainable energy applications.

VITO has successfully optimised GDEx operational parameters for processing natural brine solutions, achieving lithium removal efficiencies exceeding 95%. The extracted lithium, initially in the form of Li-Al layered double hydroxides, requires further processing into lithium carbonate for battery production. Moving forward, VITO aims to refine reactor design and

optimise energy consumption while exploring the extraction of other CRMs. This advancement could significantly reduce the environmental impact of the battery industry and lessen reliance on scarce natural resources.



Share Your Views! Survey on Public Opinion Regarding Mining and Geothermal Projects

by crm | Jan 29, 2025 | News | 0 comments

Our survey aims to gather insights into the reasons behind public support or opposition to mining and geothermal projects. The objective is to ensure that Environmental, Social, and Governance (ESG) requirements are effectively integrated into the framework conditions for the combined extraction of critical raw materials (CRM) and energy.

We kindly invite you to participate in this short survey via the following link: **https://ec.europa.eu/eusurvey/runner/CRMGeothermalpublicsurvey-a**

Please note that the survey is anonymous, and responses will be incorporated into the public deliverables of the CRM-Geothermal project. Completing the survey takes approximately **seven minutes**.

To facilitate participation, we have created **auto-translated versions** of the survey, making it more accessible to all interested citizens. While we acknowledge that the translations may not be perfect, we hope they help ensure broader engagement.

Thank you for your valuable contribution!

Different language versions:

CRM-geothermal at the EU Raw Materials Week 2024

by crm | Dec 7, 2024 | News | 0 comments

Are you attending this year's edition of the EU Raw Materials Week in Brussels? Don't miss out on the events in which our project is participating:

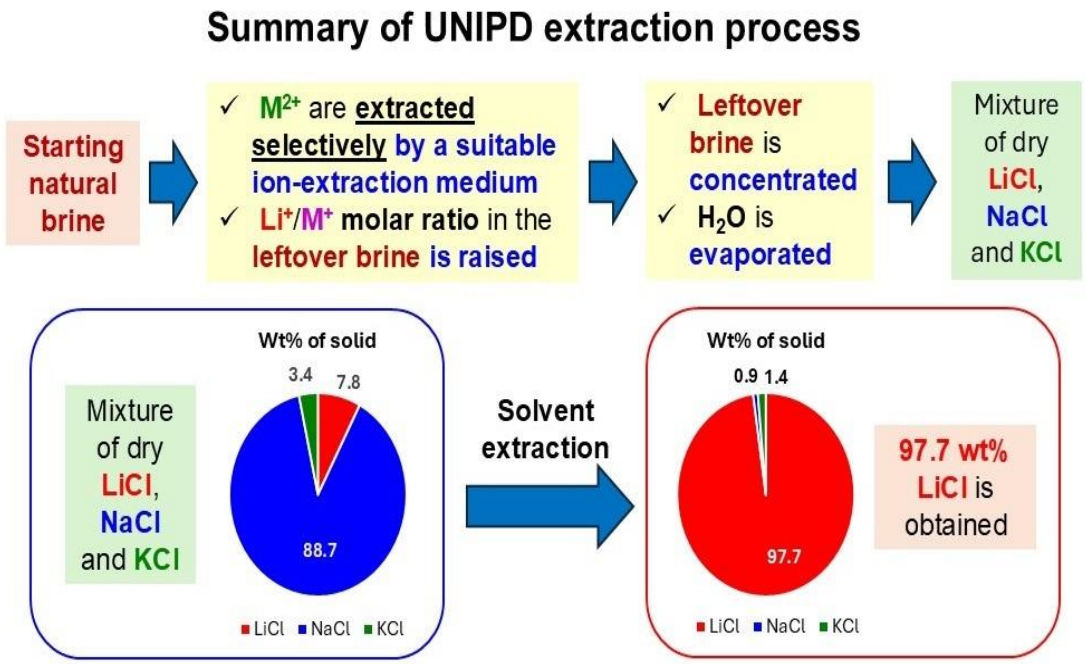
On **10 December**, project coordinator Katrin Kieling will present CRM-geothermal at a side event of the EU Raw Materials Week: "Supporting the Critical Raw Materials Act: Research Projects in the European Union".

In addition, our project is in charge of organising this year's edition of the the third edition of the annual workshop of the annual workshop of the Cluster Hub "Production of raw materials

for batteries from European resources" which will be held on **12 December in a hybrid format**.

New milestone reached: Membranes and extraction fluids developed

by crm | Dec 6, 2024 | News | 0 comments



The University of Padua (UNIPD) recently completed a new milestone for CRM-geothermal relating to the development of membranes and extraction fluids.

The related project task focused on the development of ion-exchange polymers formed into beads able to carry out the separation of Li^+ from the other cations found in a brine (*e.g.*, Na^+, K^+, Mg^{2+}, Ca^{2+}). In a later step, such ion-exchange polymers will be formed into membranes to carry out such separation in conjunction of an *"extracting fluid"*.

At the present stage, lithium separation from the brine is carried out by a multi-step process. The latter consists in the following elementary steps:

(i) selective binding of the brine cations into the beads;

(ii) concentration of the cations and modulation of the counter-anions; and

(iii) final separation of lithium by means of high-efficiency solvent extraction.

The beads used for selective lithium separation consist of a very inexpensive ion-exchange aromatic polymer, whose production is straightforward and whose physicochemical properties are easy to modulate to tailor selectivity.

UNIPD will mainly focus on the extraction of lithium from the brines, strontium extraction being considered for a later stage. The lithium extraction will be first tested on synthetic brines and later implemented on natural brines.

UNIPD research team

Prof. Vito Di Noto

Prof. Enrico Negro

Prof. Keti Vezzù

Dr. Gioele Pagot

16 December: Consultation on good practice guidelines for geothermal – metal extraction

by crm | Nov 29, 2024 | News | 0 comments

Where:

Killifreth Room,
Chacewater Village Hall
Church Hill TR4 8PZ United Kingdom

When: 16 December 2024

6:30 – 8:30 pm GMT

As the world shifts away from fossil fuels, governments and industry are looking at new ways to produce the metals and clean energy that underpin this transition. Historically, geothermal projects have been used as a source of clean energy, but there is a growing realisation that the hot waters extracted from underground can contain valuable metals and minerals that can be economically and sustainably co-produced, whilst generating power and supplying heat to communities. Cornwall is at the forefront of this developing industry, being host to several developing geothermal projects, large numbers of high temperature brine deposits and a long history of metal mining.

Effective community engagement relies on the developer understanding existing environmental and economic concerns to effectively disseminate information that is inclusive and relevant.

The Horizon Europe-funded CRM-geothermal project is asking people living and working around Redruth and in West Cornwall to help shape future development of dual geothermal energy and metals extraction projects. We are in the process of developing guidelines for successful two-way communication between a developer and the local community. Your input is vital in answering critical questions, such as: How would you like to be consulted when future projects are being developed and implemented? What is the best way for you to voice your opinion and have your questions answered? How would you like to be kept updated on project developments? **Your input will help develop a set of best practices that can be used by the developers of future geothermal projects in Cornwall, the rest of the UK and other European countries.**

Join us for an interactive session with the CRM-geothermal project team, including local developers Geothermal Engineering Ltd (GEL) and Cornish Lithium and responsible mining consultancy Levin Sources. Be part of the conversation and help create a sustainable future for Cornwall and globally!

The Horizon Europe-funded CRM-geothermal project is developing an innovative technology solution which combines the extraction of critical raw materials and energy from geothermal fluids to decrease the European Union's dependency on imported resources, supporting the EU Green Deal. This approach will also help shift some metal production away from traditional mining operations to a potentially lower impact alternative.

Please note that the conversation will cover how communities should be consulted on dual geothermal-metal extraction projects in general and what this means in terms of guidelines for responsible production. It is not intended to be a consultation on a specific project. If you have questions regarding a specific project, please contact the relevant developer directly.

For any questions about the event, please contact crmconsultations@levinsources.com

Refreshments will be provided. Parking available.

Iceland sampling campaign: Investigating presence of REE in Icelandic geothermal waters

by crm | Nov 29, 2024 | News | 0 comments

Example of field-filtration set-up (Photo: L. Klose)

Constructor University Bremen researchers, led by Prof. Dr. Michael Bau and Dr. Lukas Klose, recently embarked on a scientific expedition to Iceland. In collaboration with Prof. Dr. Andri Stefánsson from the University of Iceland, the team conducted a sampling campaign to investigate the unique geothermal hot springs found on the island.

Example of natural hot spring sampled during field campaign. (Photo: M. Bau)

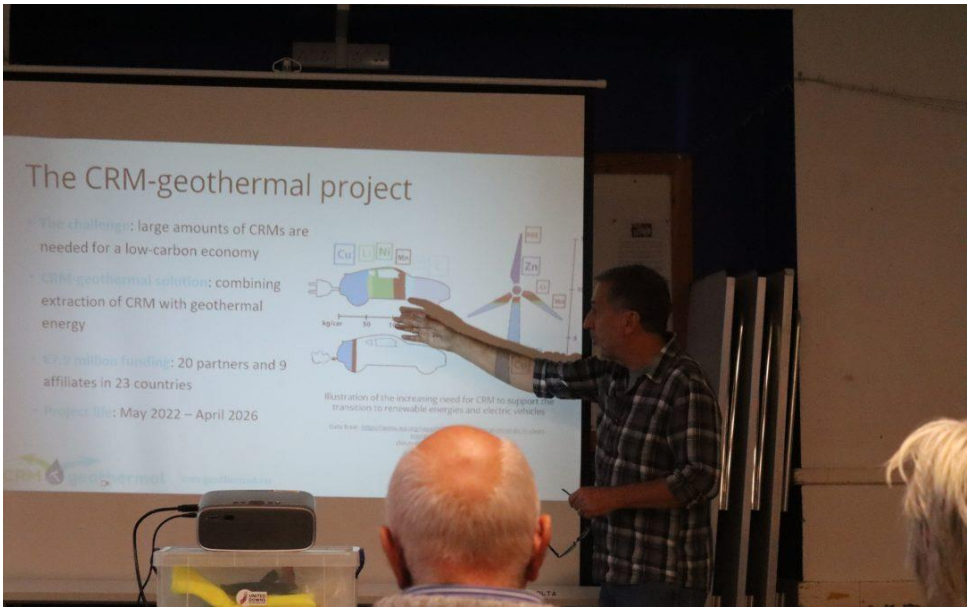
The research focuses on high-pH hot springs located in various rock type, including mafic and felsic lithologies. Samples from geothermal fluids were collected for detailed chemical analysis, with a particular emphasis on the presence and the distribution of the rare earth elements (REE) in Icelandic geothermal waters. The results will complement and enlarge the limited REE data currently available and allow for comparison with hots springs and geothermal waters in East Africa.

The research team aims at gaining a better understanding of the processes that influence the concentration, fractionation and behavior of the REE in high-pH fluids at elevated temperature and at different availabilities of ligands for complexation. The findings from this study could have significant implications for evaluating the potential of hot springs and geothermal waters as unconventional (re)sources of REE.

Example of steaming stream fed by geothermal hot springs. (Photo: L. Klose)

Learning from the CRM-geothermal social licence to operate consultation

by crm | Nov 12, 2024 | News | 0 comments



In October 2024, the CRM-geothermal project hosted a consultation in Cornwall (UK) to gather the thoughts of local communities and other stakeholders on how dual geothermal-metal extraction projects can achieve 'social licence to operate' in the UK, EU and beyond. The consultation findings will ultimately be captured in *Guidelines for Obtaining and Maintaining Social Licence to Operate*, a 'how-to' manual currently being developed by one of the project's partners, Levin Sources.

During the consultation, five key themes emerged, offering valuable insights for shaping the guidelines around community consultation in the context of SLO for this type of project.

1/ Honesty and transparency are key

The overwhelming message that emerged from the consultation was the need for open, honest and transparent communication. Stakeholders want to feel heard, seen and respected. They highlighted the importance of providing consistent updates on what a project is doing and why – including transparency about what is unknown or advance notice of negative impacts, such as noise from drilling. This approach helps build trust and public confidence, which will pay off in times of uncertainty.

SLO is closely linked to trust, which is easy to lose and difficult to build. It is therefore vital that a dual geothermal-metal extraction project can meet any commitments it makes to local and other stakeholders or proactively and clearly explain why it cannot. Broken promises and unmet expectations are hard to recover from.

2/ Make your information accessible

From school children to experts, every member of the community needs to understand the project's communication. Making the messaging both serious and fun encourages interaction. This means using simple language adapted to each audience group, avoiding unnecessary jargon and explaining technical concepts through relatable comparisons. Simplicity, however, doesn't mean oversimplification, but rather accounting for the public's different levels of understanding and existing knowledge by providing different levels of entry.

In regions with distinct local dialects, consider sharing information in multiple languages, especially to reach older generations. Use different forms of communication, including simple graphics, to explain the project to those with limited literacy or who access information more easily through visual media.

3/ Consider the community context

Tailor the communication guidelines to a specific community by developing a thorough understanding of the audience and public. This will vary from project to project. A project can work with 'trusted messengers' to distribute information but this approach can backfire if the trusted messengers have a negative view of the project. They will often be local stakeholders with direct influence, but their local role and network of stakeholder contacts can vary widely from one place to another.

4/ Be proactive in engaging stakeholders

Stakeholders want projects to reach out to them rather than the other way round. Proactively engaging from the early stages, such as during the site selection process, can help avoid misunderstandings and build strong relationships. When consultation is not possible, projects should explain why a decision was taken without community input.

While controlling the narrative is important, addressing misinformation should not come at the expense of addressing stakeholders' genuine concerns and opinions. Projects need to explain to stakeholders how their views have been considered and addressed so they feel heard and valued.

5/ Think beyond the project

"Do no harm" is the baseline for projects, but stakeholders agree that "improve things" is a more inspiring goal for communities, alongside commitments to support communities in a way that brings sustained benefits beyond a project's life.

Projects should seek to invest resources, both financial and skills-based, in host communities or communities that potentially will experience adverse impacts. Job creation and spending to support the local supply chain through use of local goods and services are important ways of demonstrating a commitment to community improvement, but more innovative approaches may also sometimes be possible (such as issuing shares to local people and redirecting "waste" heat from the project to community greenhouses).

By considering and responding to these five key themes and creating a transparent, accessible, and context-specific communication strategy, dual geothermal-metal extraction projects can deliver more meaningful community engagement, build trust, foster cooperation and support from local stakeholders and progress on their journey to obtaining and maintaining SLO.

Photos: Dr Paul Mitchell delivering the workshop – Image credit: GEOTHERMAL ENGINEERING LTD

Lead researcher: Paul Mitchell (Levin Sources)

Student Stories: Characterisation of a Geothermal System in Fractured Crystalline Rocks by Thermal-Hydraulic-Chemical Modelling at United Downs

by crm | Sep 10, 2024 | News | 0 comments

In his Master Thesis, Samuele Frigo performed the characterisation of the geothermal system in fractured crystalline rocks at United Downs (Cornwall, UK) by means of Thermal-Hydraulic-Chemical modelling. Samuele is a Master student from the University of Greifswald, where he studied Earth Sciences. For his Master thesis, he joined the GFZ Potsdam and the CRM-geothermal project.

Samuele's study aims to contribute to the development of a pilot plant for the co-production of lithium (Li) and geothermal energy from a low-salinity crystalline reservoir in SW England, operated by Cornish Lithium Ldt. The objectives of his study are to characterise the geothermal system under analysis in terms of hydraulics and geochemistry and evaluate the long-term sustainability of the potential co-production operations on site. The multifaceted approach adopted in his research combines traditional hydrogeological and geochemical fieldwork, laboratory and data analysis, and advanced numerical methods.

The field campaign took place between June and July 2023. The fieldwork encompassed hydrogeological testing, chemical-physical fluid monitoring, and sampling fluids and scales from two relatively shallow boreholes (~ 800 and 1100 m depth). The boreholes, 214 meters away at surface, intersect two highly permeable fracture zones between 600 and 700 m depth known to be highly conductive to hot and Li-enriched fluids. Figure 1 shows the pressure drawdown in the production well GWDD_001 during the step-rate airlift test, as well as the relative calculated Productivity Index (PI)—a useful parameter to evaluate the hydraulic performance of the system.

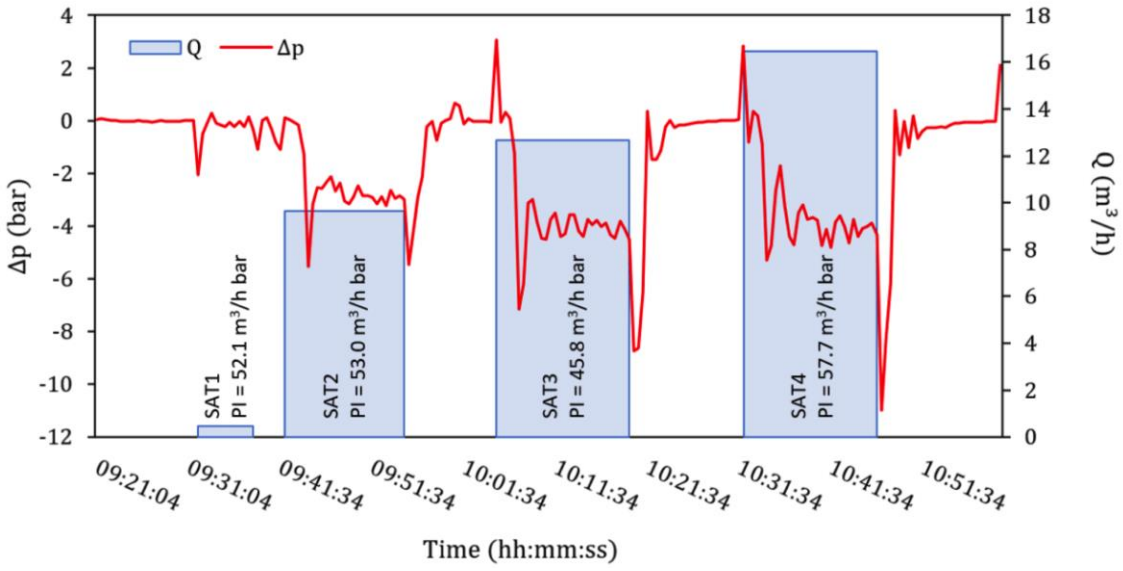


Figure 1: Discharge Q, pressure drawdown Δp and Productivity index PI estimation during the step-rate airlift test. The high estimated PI suggest a good response of the system to fluid production (Frigo, unpublished).

During these tests, Samuele and several CRM-geothermal partners also took gas, fluid and scale samples for subsequent chemical analysis. The analysis results were then used by Samuele for a simple sequential thermodynamic equilibrium modelling with PHREEQC to investigate and quantify the scaling processes potentially occurring during geothermal operation. Precipitation of several mineral phases – mainly including Fe and Al bearing phases, silica, calcite, and fluorite – seems to occur upon production to the surface. Importantly, the aeration of fluids results in a 7-fold increase in scaling magnitude with respect to the operation in anoxic conditions.

Making use of MOOSE/GOLEM, a 3D model simulating coupled thermal, hydraulic and conservative mass transport processes (THC) occurring within the fractured geothermal system (Figure 2) was developed. The THC model was used to evaluate the thermohydraulic and chemical evolution of the system under different production scenarios with varying discharge and injection rates. All THC simulations display positive results, suggesting the modelled pump rate of 25 kg/s as the most suitable for commercial developments, whether the focus is to maximise both power generation and Li extraction.

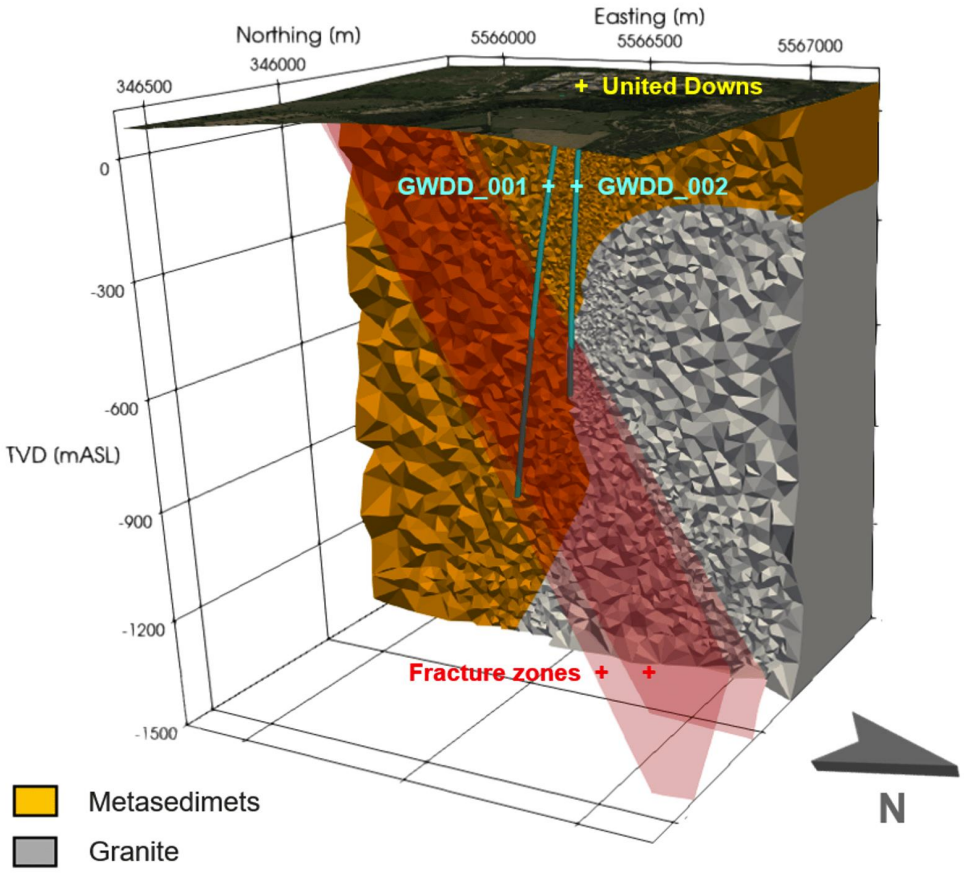


Figure 2: Structural model of the shallow geothermal site at United Downs used to perform the 3D THC simulations with MOOE/GOLEM. The model includes two porous matrix lithologies – granite and metasediments – two steeply dipping fracture zones, and two wells. The structural

model was adapted from a previous version provided by Cornish Lithium Ltd. (Frigo, unpublished).

The outcomes of Samuele's study, which will be presented in detail in an upcoming publication, suggest that the reservoir at the site of the CRM-geothermal partner Cornish Lithium Ltd. is suitable for long-term heat and mineral extraction. They also highlight scaling potential, such that adequate countermeasures could be applied for the future operation of the system.

Samuele conducted his Master study under supervision of Prof. Dr. M.-Th. Schafmeister (University of Greifswald) and PD Dr.-Ing. M. G. Blöcher and PD Dr. Simona Regenspurg (GFZ).

Influence Consultation Event in Cornwall

by crm | Sep 4, 2024 | News | 0 comments

Where: Redruth Community Centre

9a Chapel Street Redruth TR15 1AN, United Kingdom

When: 9 October 2024

2 – 4 pm or 6 – 8 pm

As the world shifts away from fossil fuels, governments and industry are looking at new ways to produce the metals and clean energy that underpin this transition. Historically, geothermal projects have been used as a source of clean energy, but there is a growing realisation that the hot waters extracted from underground can contain valuable metals and minerals that can be economically and sustainably co-produced, whilst generating power and supplying heat to

communities. Cornwall is at the forefront of this developing industry, being host to several developing geothermal projects, large numbers of high temperature brine deposits and a long history of metal mining.

Effective community engagement relies on the developer understanding existing environmental and economic concerns to effectively disseminate information that is inclusive and relevant.

The Horizon Europe-funded CRM-geothermal project is asking people living and working around Redruth and in West Cornwall to help shape future development of dual geothermal energy and metals extraction projects. We are in the process of developing guidelines for successful two-way communication between a developer and the local community. Your input is vital in answering critical questions, such as: How would you like to be consulted when future projects are being developed and implemented? What is the best way for you to voice your opinion and have your questions answered? How would you like to be kept updated on project developments? **Your input will help develop a set of best practices that can be used by the developers of future geothermal projects in Cornwall, the rest of the UK and other European countries.**

Join us for an interactive session with the CRM-geothermal project team, including local developers Geothermal Engineering Ltd (GEL) and Cornish Lithium and responsible mining consultancy Levin Sources. Be part of the conversation and help create a sustainable future for Cornwall and globally!

The Horizon Europe-funded CRM-geothermal project is developing an innovative technology solution which combines the extraction of critical raw materials and energy from geothermal fluids to decrease the European Union's dependency on imported resources, supporting the EU Green Deal. This approach will also help shift some metal production away from traditional mining operations to a potentially lower impact alternative.

Please note that the conversation will cover how communities should be consulted on dual geothermal-metal extraction projects in general and what this means in terms of guidelines for responsible production. It is not intended to be a consultation on a specific project. If you have questions regarding a specific project, please contact the relevant developer directly.

For any questions about the event, please contact crmconsultations@levinsources.com

Refreshments will be provided. Parking available.

Register by 8 October