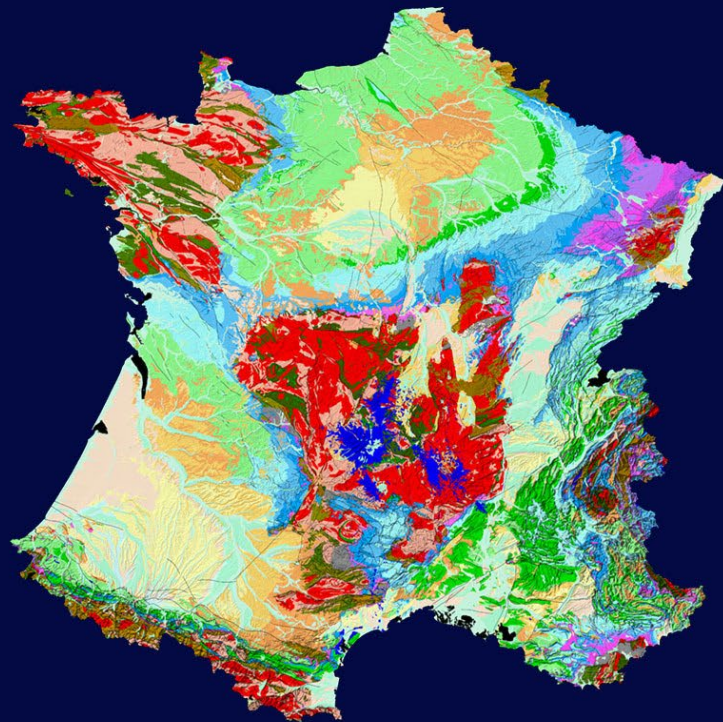


LCA-SUB

Antoine Beylot (BRGM)

Guido Sonnemann (Université de Bordeaux)



LCA-SUB: Plateforme sur l'évaluation environnementale et la pensée cycle de vie pour une utilisation durable du sous-sol

Antoine Beylot (BRGM), Guido Sonnemann (Université de Bordeaux)

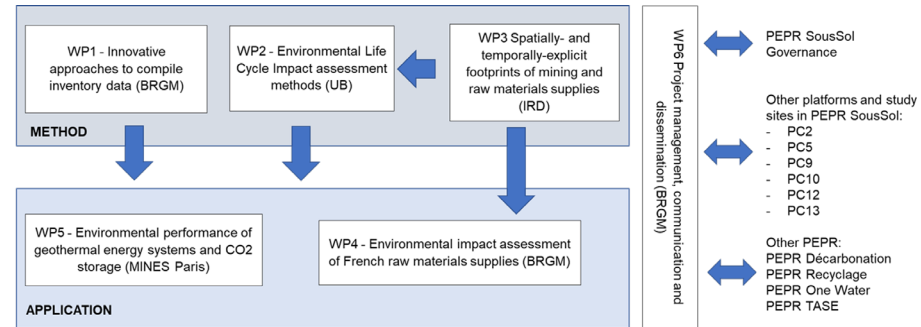


Budget : 2 113 000 €



Objectifs:

- **Evaluation environnementale** des perspectives offertes par **l'exploitation potentielle future du sous-sol français: menaces et opportunités** au regard des défis **environnementaux locaux et globaux**
- Analyse des potentiels **transferts d'impacts** i) entre diverses **catégories d'impact environnemental**, ii) dans le **temps** et iii) entre les **régions du monde**
- Améliorer les **méthodes** et les **données** de la **Pensée Cycle de Vie**



Post-doctorat de Jad Diab



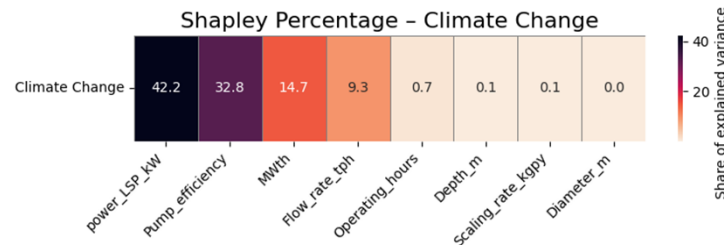
- **Evaluation environnementale des systèmes de production d'énergie via la géothermie – paramétrisation et cas d'étude**

- **Résultats clés :**

- Mise à jour du cas de Rittershofen
- Développement d'un modèle de dépendance via Shapley

- **Valorisation scientifique en perspective:**

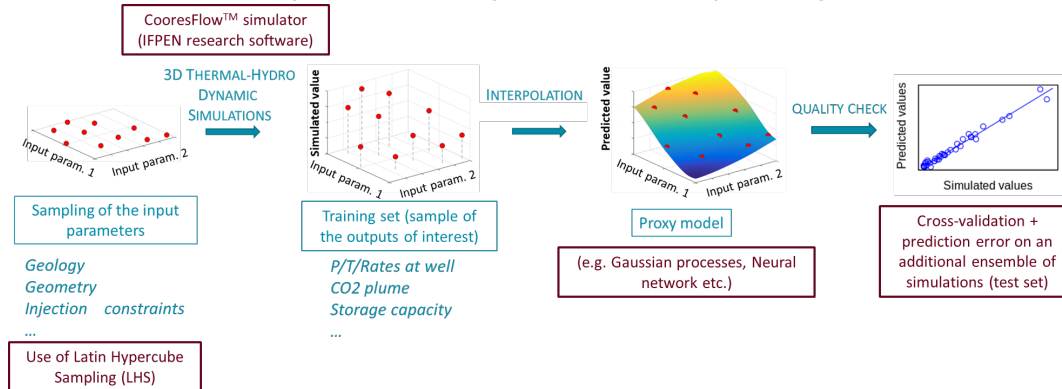
- Incertitude et dépendance en ACV – en cours
- Articles méthodologique (modèle de dépendance appliqué à Rittershofen) et d'étude de cas (application de la méthode sur le Bassin Parisien)



Life Cycle Assessment of CO₂ geological storage

Development of **Life Cycle Inventories (LCI)** and **Life Cycle Assessment (LCA)** models specific to CO₂ geological storage sites, taking into account leakage risks

- Building and training of **fast meta-models** to replace the physical simulations in the risk estimation process considering **machine learning-based approaches**
- A set of a few **representative reservoir models** with associated uncertainties will be built, considering different types (e.g. depleted gas field, saline aquifers) typologies (sandstones, carbonates etc.), and leakage scenarios (damaged well, fault reactivation).



Debashmita Poddar
18-months post-doctoral researcher
Starting date : **January, 5th**

Post-doctorat de Florent Feriol



- **Estimation de l’empreinte foncière et temporelle des activités minières grâce à l’imagerie satellitaire**
- **Résultats importants** : Création d’une **base de données annotée et focalisée sur l’orpillage**, premier modèle de **segmentation d’images**
- Futurs travaux :
 - **Missions terrain CIV** (afin de faciliter l’étiquetage des images) et Pérou (approche interdisciplinaire sous l’angle de la géologie politique)
 - **Augmentation de la BDD** et évaluation de différents modèles, analyse des résultats

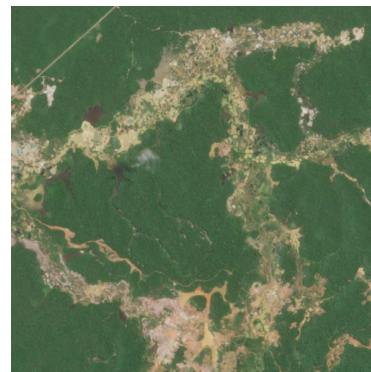
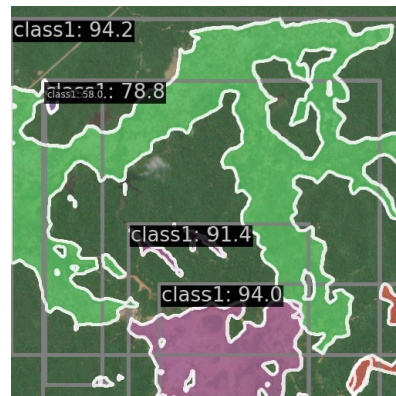


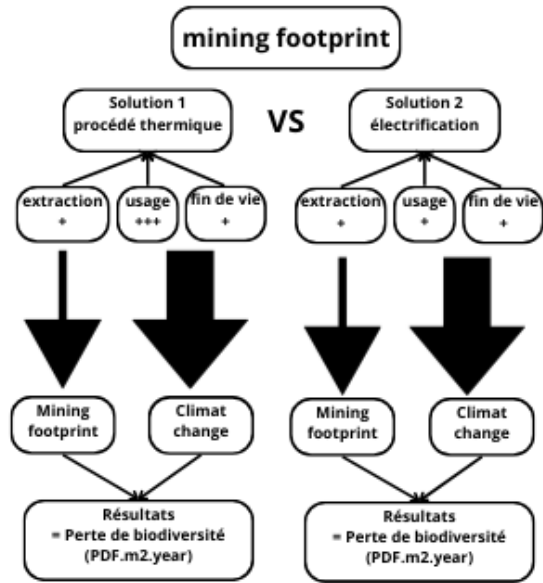
Image originale (Brésil)



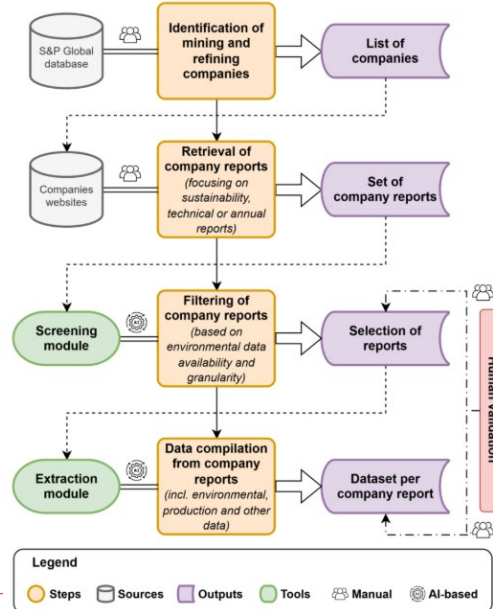
Prédiction des masques

Empreinte environnementale de la mine - Highlights

- Thèse d'Ulysse Pointud



- Collaboration avec le PC3 TAEF sur le **potentiel de l'IA pour la génération de datasets ICV** sur la base de rapports environnementaux de compagnies minières



- Post-doctorat de Charaf Bejjit
- Cas d'études Cu et Ni
- Article en préparation

Articles scientifiques en collaboration - Highlights

- **Lagae Capelle, E., Beylot, A.,** Coudert, L., Demers, I., Neculita, C. N., Noirant, G., Pépin, G., **Muller, S.** *Comparative life cycle assessment of scenarios of low sulfide tailings management: identification of hotspots towards eco-design.* Submitted to IJLCA (2025)

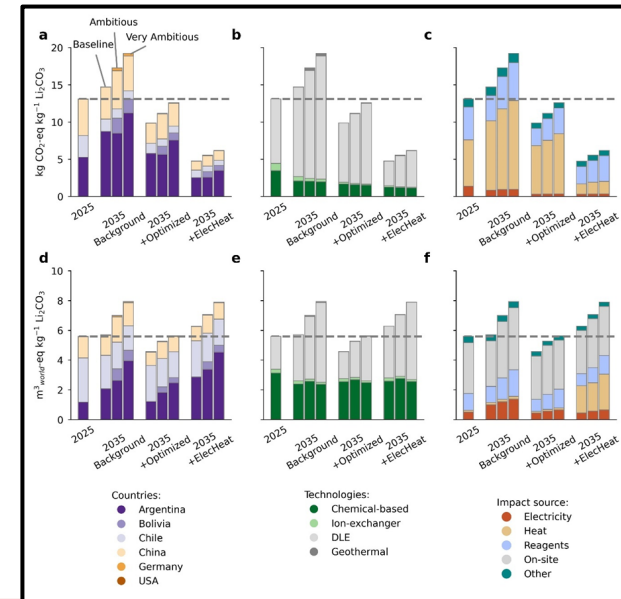
**Prix Jeunes Chercheurs
de la SIM 2025** pour ses
travaux en collaboration
UQAT-BRGM



Articles scientifiques en collaboration - Highlights

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- Sakatadi, G., **Beylot, A., Lai, F.,** Hippmann, S., Pavón, S., Blengini, G. A. *How can prospective life cycle assessment support the eco-design of an innovative battery-grade lithium carbonate production process?* Submitted to RCR (2026)
- Istrate, R., Schenker, V., **Beylot, A., Collignon, V.,** Pfister, S., Steubing, B. *Future environmental performance of lithium from brines shaped by energy and reagent decarbonization and technology optimization.* Submitted to ES&T (2026)
- Husmann, J., Northey, S., **Beylot, A.** et al. *Inconsistencies in handling of multifunctionality in the environmental footprint of electric vehicle batteries: a cross-industry analysis.* Int J Life Cycle Assess 30, 1560–1578 (2025). <https://doi.org/10.1007/s11367-025-02506-y>

Prix Jeunes Chercheurs de la SIM 2025 pour ses travaux en collaboration UQAT-BRGM



Events/Workshops – International Working Group on LCA of Mineral Raw Materials

- ✓ ~150+ participants
- ✓ Europe, Amérique du Nord, Australie, Asie
- ✓ **Article** en préparation en 2026

1st Workshop on Challenges in Conducting Life Cycle Assessment of Mineral Raw Materials

The International Working Group on Life Cycle Assessment of Mineral Raw Materials

WORKSHOP TO EXPLORE

Challenges in Conducting LCA of Mineral Raw Materials

2025

OPTION 1
Virtual


OCT 08

8:00 AM - 11:00 AM Central time

Topics

- ❖ Data Quality and Availability
- ❖ Methodological Development for Mineral Resources
- ❖ Decision Support Integration

sites.mst.edu/minerallca
 nnh5@mst.edu





PURPOSE

To develop a pragmatic roadmap for more robust environmental impact assessments of mineral raw materials by identifying gaps in the life cycle assessment (LCA) of mineral extraction processes, developing transparent and reproducible LCA methodologies for the sector, and supporting sustainable mineral resource extraction.

WHO SHOULD ATTEND

Sustainability professionals in mining and quarrying companies, consulting firms specializing in LCA and sustainability, industry associations, and government institutions focused on mineral resources.





International Working Group on LCA of Mineral Raw Materials

[Home](#) [Our Work](#) [Collaborators](#) [Contact](#) [Events/Workshops](#)

Collaborators



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[Profile](#)



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Environmental engineer – Scientific expert
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Research Engineer, Environmental Assessment
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Dr. Gian Andrea Blengini

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giovannandrea.blengini@unito.it



Dr. Kamrul Islam

Researcher, National Institute of Advanced Industrial Science and Technology (AIST).



Dr. Isabella Bianco

Researcher, Politecnico di Torino, Italy

Nous recrutons!

- **Post-doc INERIS – 18 mois**



Offre ouverte

Objectif : *Apporter des connaissances permettant potentiellement d'améliorer les modèles ACV concernant l'émission de métaux issus des stockages de déchets miniers et leur impact sur les écosystèmes et la santé humaine*

- **2 Post-docs BRGM – 24 mois**



- Post-doc **Modélisation (ACV) prospective**
- Post-doc **Modélisation prédictive (Simulation de procédés / ACV)** pour soutenir l'éco-conception de procédés. Post-doc de 1 an PC5 (InnovTech) + 1 an PC6 (LCA-SUB)
- **Une thèse BRGM** – lancement en septembre 2026

Advancing the assessment of environmental criticality: supply risk induced by environmental pressures from current and potential future exploitation of the EU subsurface

Merci de votre attention

a.beylot@brgm.fr

PC6: LCA-SUB

Environmental assessment and Life Cycle thinking for A sustainable use of the SUBsurface



26/01/2026

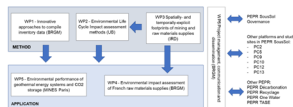
Auteurs

Antoine Beylot*, BRGM, Guido Sonnemann, Université de Bordeaux, Mathilde Marchand, Mines Paris, Jad Diab, Mines Paris, Guillaume Babié, IFPEN, Debashmita Poddar, IFPEN, Sibylle Duval-Dachary, IFPEN, Vincent Grammont, INERIS, David Baratoux, IRD, Jérémie Cavé, IRD, Florent Feriol, IRD, Ulysse Pointud, Université de Bordeaux

* a.beylot@brgm.fr

LCA-SUB will significantly advance Life Cycle Thinking methods for environmental assessment, thanks to an innovative combination of approaches and tools. It will provide an environmental assessment of the perspectives offered by the potential future exploitation of the French subsurface. It will consider, and discuss, threats and opportunities with respect to both local and global environmental challenges

Project outline



Life Cycle Assessment of CO₂ geological storage

Development of Life Cycle Inventories (LCI) and Life Cycle Assessment (LCA) models specific to CO₂ geological storage sites, taking into account leakage risks

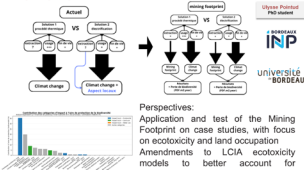
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Scientific Valorization supported by LCA-SUB

- Lagae Capelle, E., Beylot, A., Couderc, L., Demers, J., Neufils, C. N., Noirant, G., Pipin, G., Muller, S. Comparative life cycle assessment of scenarios of low sulfate ballings management: identification of hotspots towards eco-design. Submitted to IS CA (2025)
- Sakataki, G., Beylot, A., Lali, F., Hippmann, S., Pawon, S., Blenghi, G. A. How can prospective life cycle assessment support the eco-design of an innovative battery-grade lithium carbonate production process? Submitted to RCR (2026)
- Isstrate, R., Scherrier, V., Beylot, A., Collignon, V., Pflater, S., Steubing, B. Future environmental performance of lithium from brines shaped by energy and reagent decarbonization and technology optimization. Submitted to ES&T (2026)
- Mas-Freres, A., Triboulet, L., Beylot, A., Pires Herrera, D., Loubet, P., Sonnemann, G., Reuter, M. Use of process simulators in LCA of mineral raw materials production: a critical review. Submitted to Sustainable Metallurgy (2025)
- Hausmann, J., Northey, S., Beylot, A. et al. Inconsistencies in handling of multifunctionality in the environmental footprint of electric vehicle batteries: a cross-industry analysis. Int J Life Cycle Assess 30, 1560–1578 (2025). <https://doi.org/10.1007/s11367-025-02506-y>

Mining Footprint: a methodological framework



Perspectives: Application and test of the Mining Footprint on case studies, with focus on ecotoxicity and land occupation. Amendments to LCA ecotoxicity models to better account for emissions from mining activities.

Land and temporal footprint of mining activities through satellite images

- Key results so far: creation of a database annotated and focused at gold panning, first model of image segmentation
- Future work:
 - Field missions to the Ivory Coast (to facilitate image 'digging') and to Peru (interdisciplinary approach from the perspective of political geology)
 - Expansion of the database and evaluation of different models, analysis of results



Life Cycle Assessment of geothermal energy production systems

Environmental assessment of geothermal energy production systems – parameterization and case studies

- Key results so far:
 - Update of the Rittershofen case
 - Development of a dependency model via Shapley

Perspectives: on-going synergy with BRGM, and planned engagement with operators of the Paris Basin



Ce travail a bénéficié d'une aide de l'Etat gérée par l'ANR au titre de France 2030 portant la référence ANR-22-EXSS-0007

