Demonstration of battery metals recovery from primary and secondary resources through a sustainable processing methodology

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About the project…

To boost the green transition, the availability of CRM needs to be ensured. The battery sector has been experiencing increasing demand for raw materials for years and is vulnerable for supply risks. Various strategies are being pursued to meet the growing demand for critical raw materials and to build up viable, sustainable and innovative value chains. Waste valorization by recovery and recycling plays a central role.

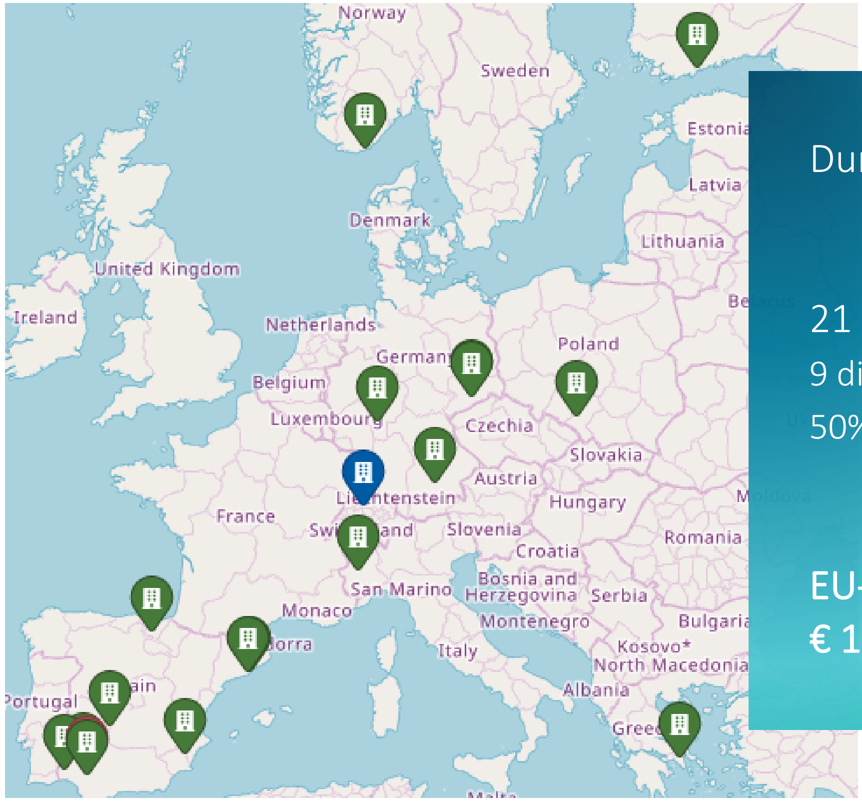
Objectives

- Recover valuable materials from primary and secondary resources (tailings)
- Demonstrate sustainable production and recovery of critical battery metals
- Assess End-use of the recovered critical battery metals
- Identify and characterise the critical battery metals with innovative technologies
- Enable social participation, stakeholder engagemet and networking

https://metallico-project.eu/

Five different processes for metal recovery from primary and secondary raw materials

- **COOL+**
  - **Li** recovery and **geopolymers** production
- **TAILCO**
  - **Co** recovery from tailings in Cu hydrometallurgical plants
- **PURGES**
  - **Co** recovery from purges generated in pyrometallurgical refining processes
- **CONI**
  - **Co**, **Ni** and **Co** recovery from waste alloys (Fe-As) generated in Pb hydrometallugical processes
- **COMAN**
  - **Co**, **Cu** and **Mn** recovery from tailings generated in ore concentration plants.



Duration: 4 Years

21 Partners
9 different countries
50% Companies

EU-Contribution:
€ 11 798 783,25 €

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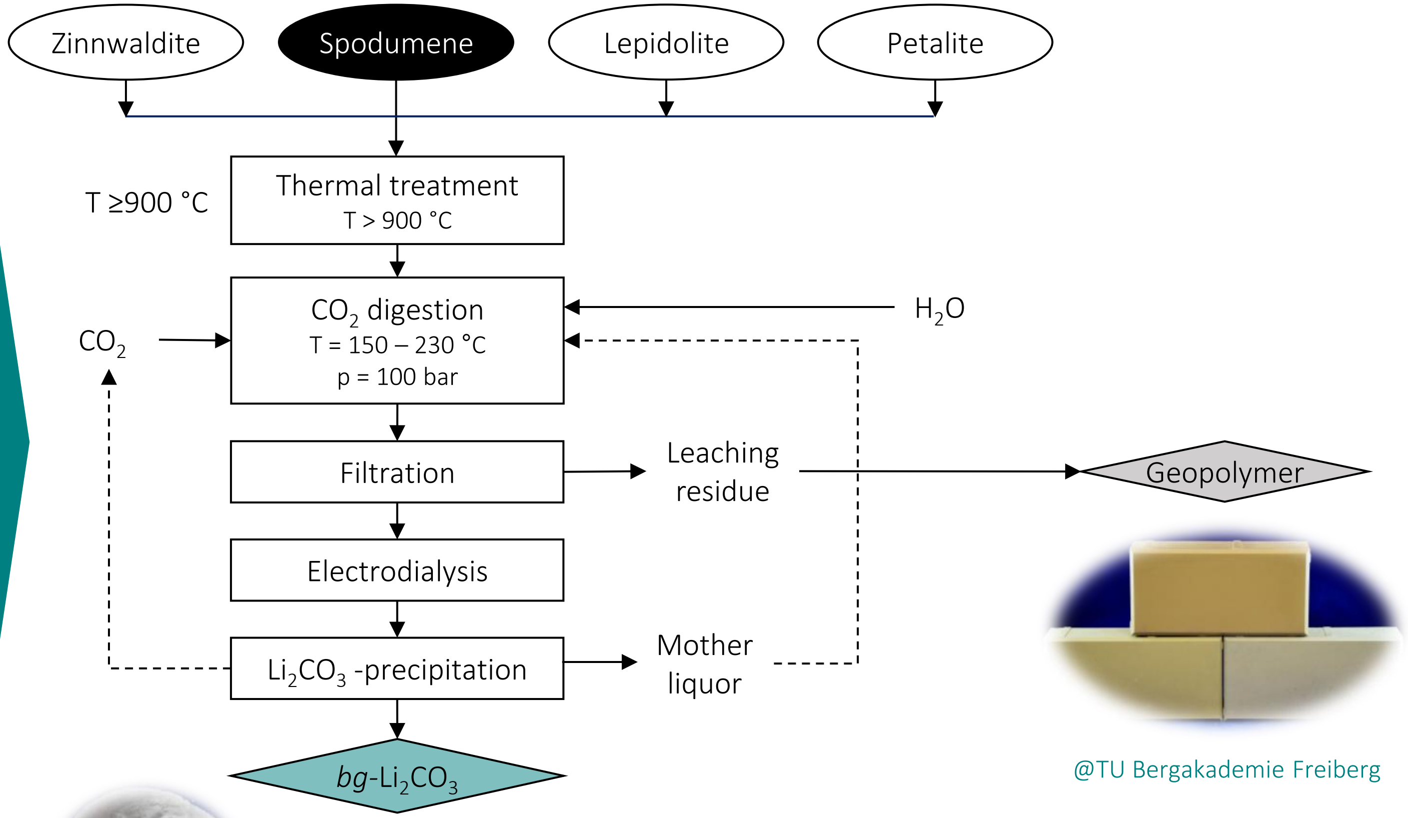
COOL Process 1.0 – previous METALLICO

Leaching with supercritical CO_2

Advantages:

- Low chemical cost
- High selectivity for Li
- Li_2CO_3 as main product in battery grade quality
- Zero-waste concept
  - Geopolymers (waste valorisation)



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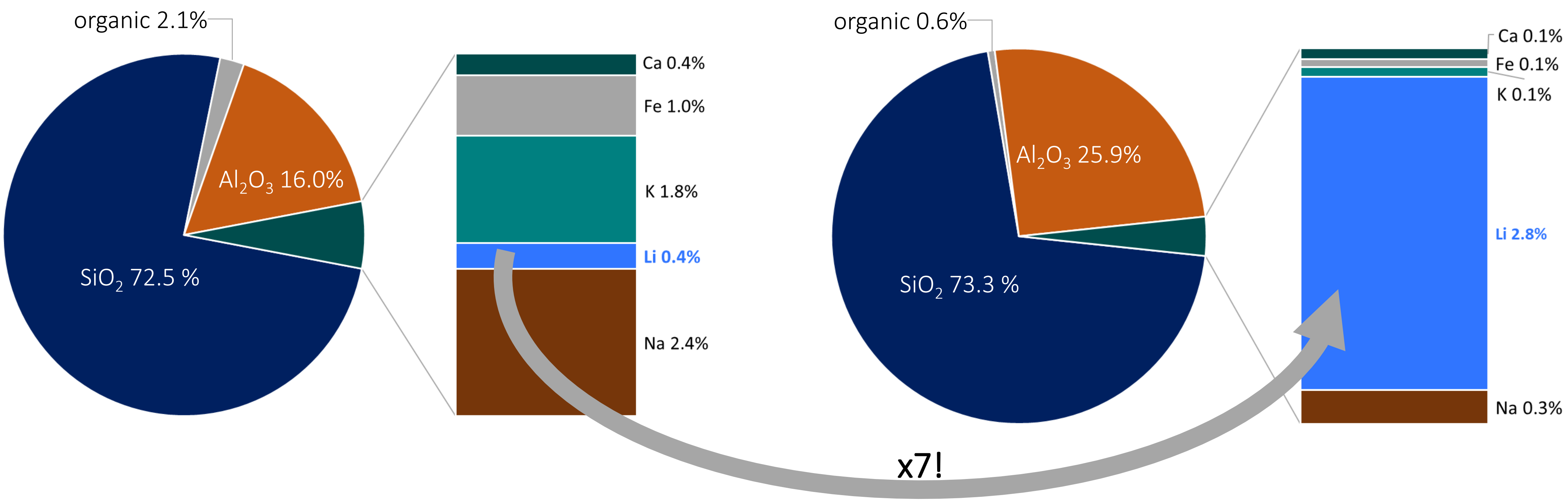
D. Zuljevic, D. Kaiser, M. Kraft, S. Pavón, S. Hippmann, A. Nickol, M. Bertau; Lithium from low grade ore – a zero waste approach - Sustain Chem Pharm 2024 under review

Spodumene from Africa

Europe (Spain)

Africa (Nigeria)



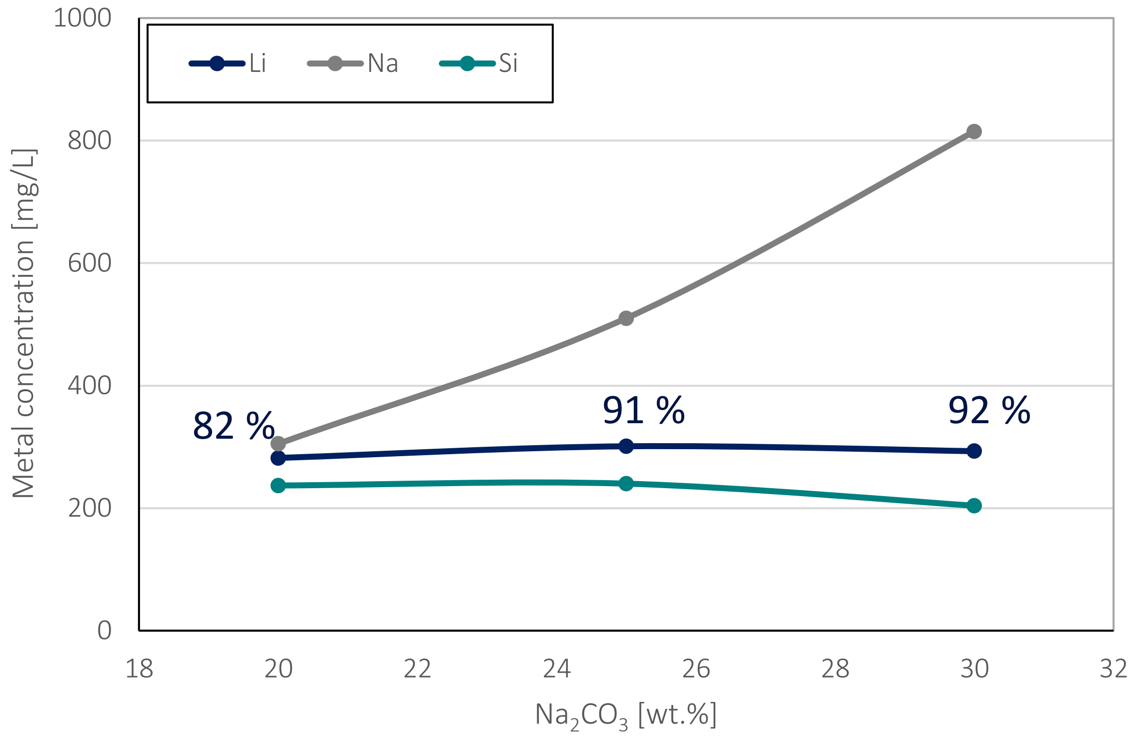
Spodumene from Africa

Calcination at 750 °C with addition Na_2CO_3

- Crystalline structure consists of ß-spodumene and nepheline
- ↑ Na_2CO_3 concentration = ↑ Li mobilisation

⚠ Co-mobilisation of Na

92 % Li-mobilisation 👏



Spodumene from Africa

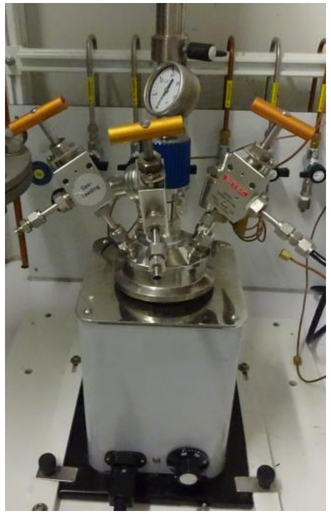
Optimized leaching conditions

- Thermal activation: 30 wt.% Na_2CO_3, 750 °C, 2 h
- CO_2 digestion: 230 °C, 100 bar, s/L-ratio 1 kg/80 L, 3 h

	Mobilisation [%]			
	Li	Al	Si	Na
Lab scale	92.0	0.7	10.6	58.2
Pilot scale	74.5	0.3	9.6	46.1

Li mobilisation differences

1 L scale



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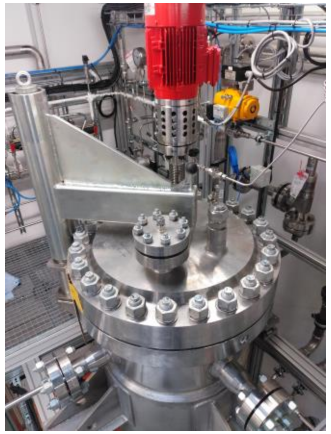
200 L scale



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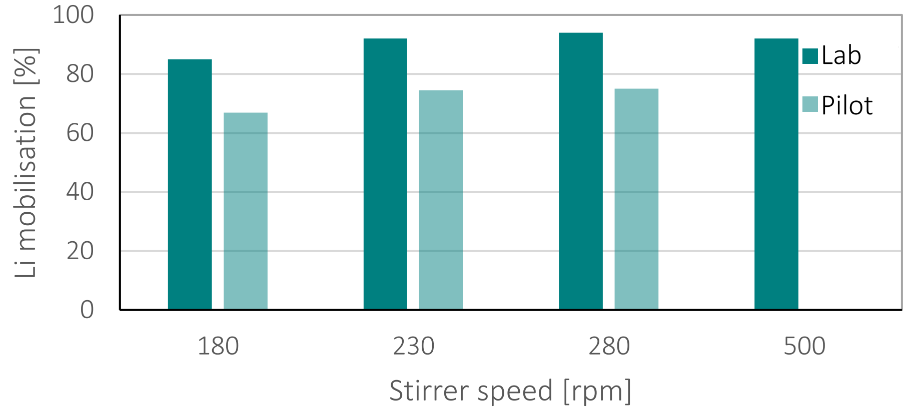
Spodumene from Africa

Lab vs. pilot scale investigations



- Stirring speed
  - ❖ Limitation in pilot scale (280 rpm) while in lab-scale ≤ 500 rpm
- Cooling system
  - ❖ Limitation in pilot scale - ca. 6 h while in lab-scale ca. 20 min
  - ❖ Carrying out lab test increasing the cooling duration
    - – Differences < 10%
- Reactor filling level
  - ❖ Lab scale (filling level ca. … %) → 75% Li mob.
  - ❖ Carrying out lab test red… …ble with results obtained in pilot scale

Reactor design!

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Spodumene from Africa

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Isolation of Li_2CO_3

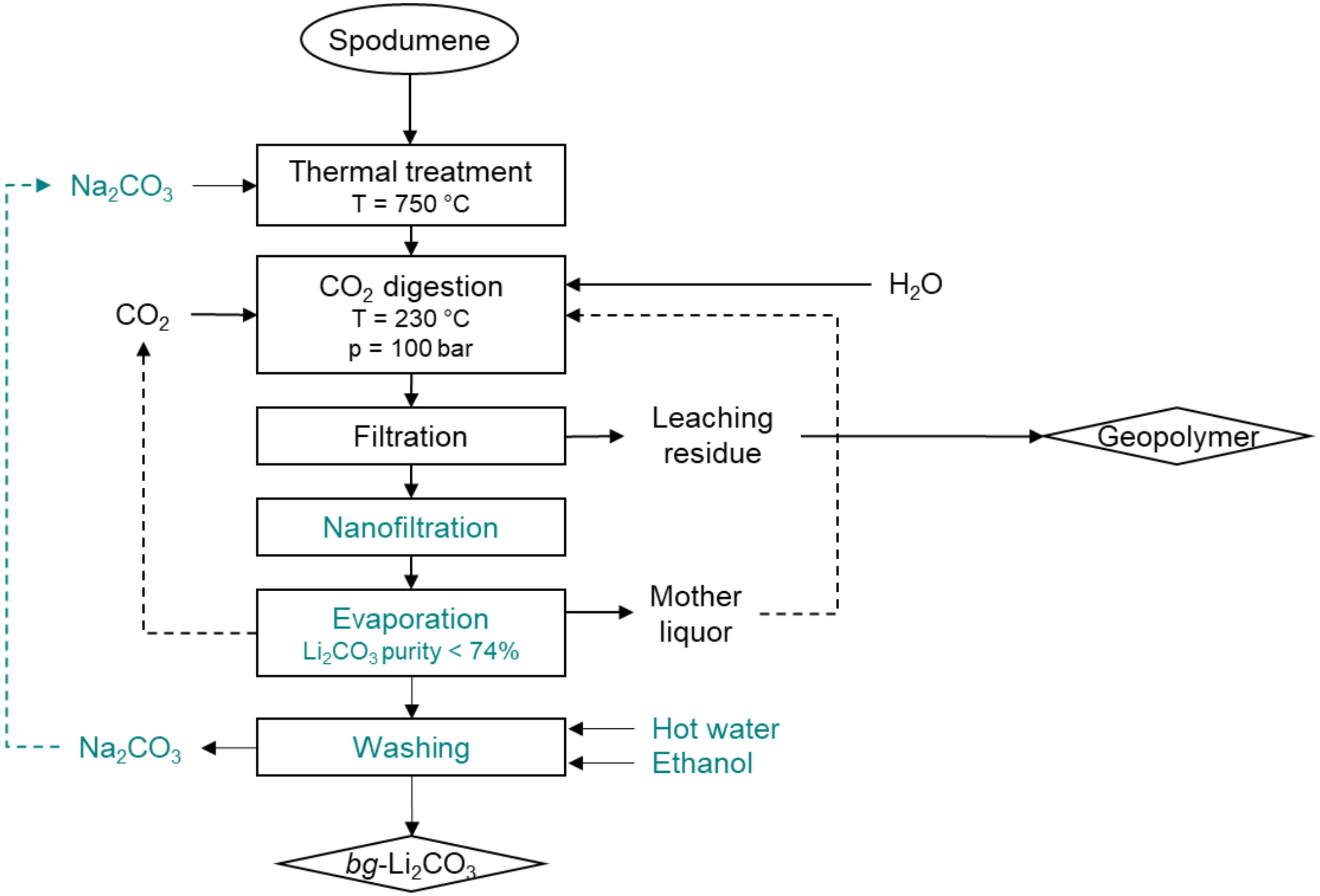
- Precipitation after evaporation
  - Purity Li_2CO_3: 74 %
  - The main impurity is Na due to co-mobilisation
  - Electrodialysis not suitable due to not availability of selective membranes for monovalent ions separation

- Washing 2-times with hot water and 2-times with ethanol
  - Purity Li_2CO_3: 99.7 % 👏

Spodumene from Africa

COOL+ Process

- Nanofiltration
  Reducing the evaporation costs in full scale
- Washing
  Purification step – hot water for removing impurities and ethanol to make the dry step easier
  →Full scale without EtOH



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Stay in contact

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