CRM geothermal

Lithium biorecovery using microbial activity

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The CRM-geothermal project

Raw materials from geothermal fluids

Ocurrence · Enrichment · Extraction

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.

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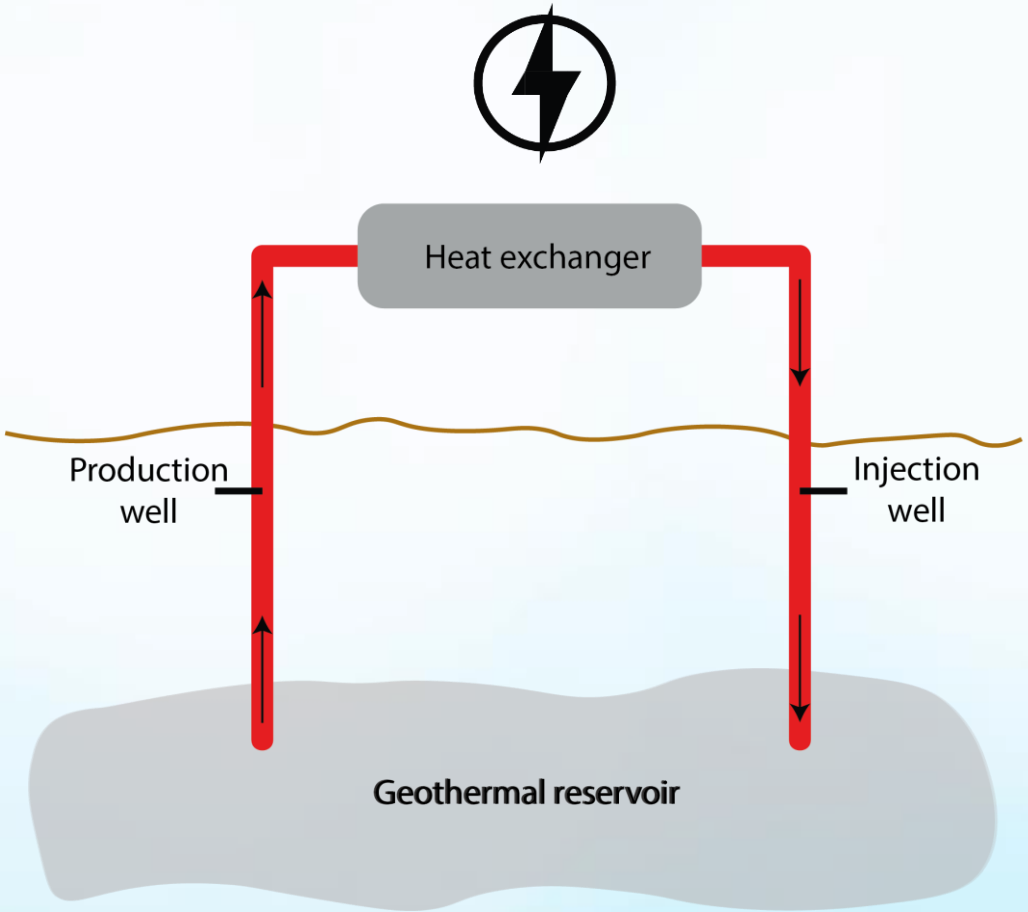
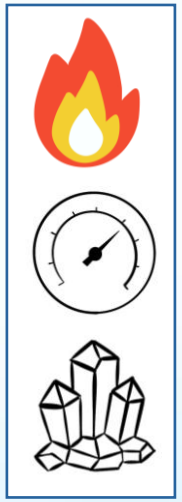
The geothermal energy context





High temperature

High pressure

High salinity

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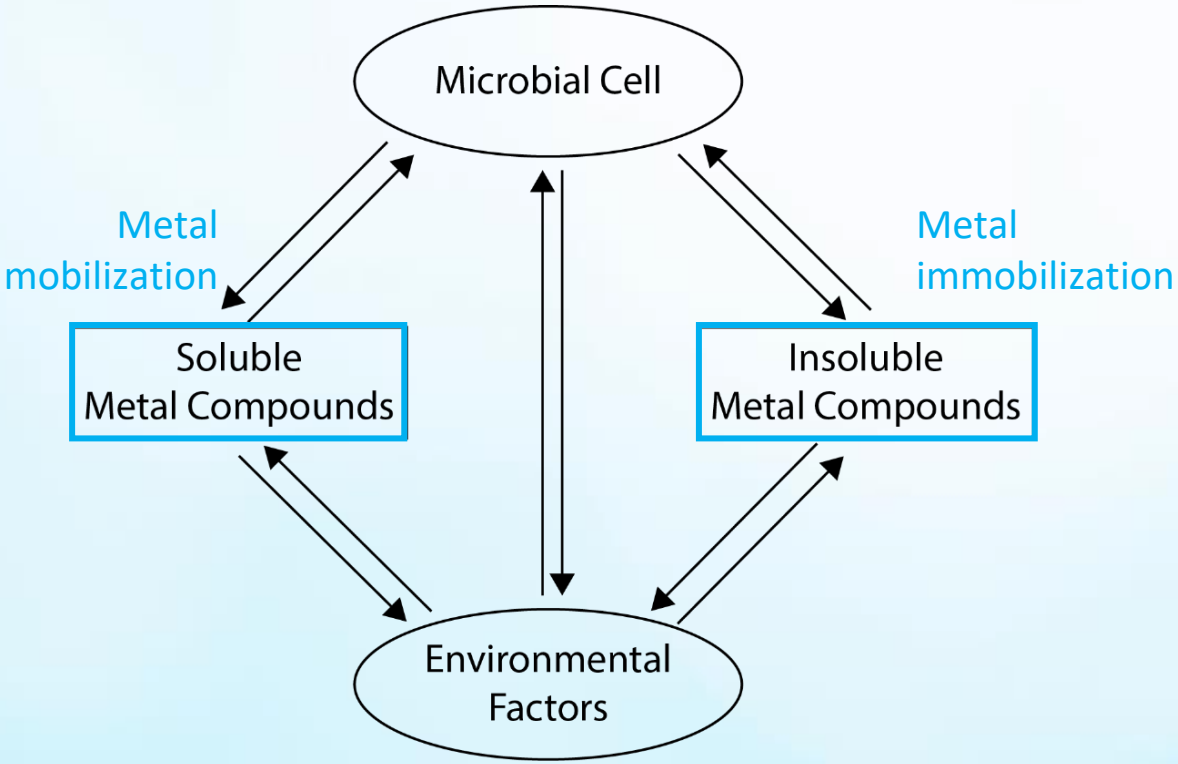
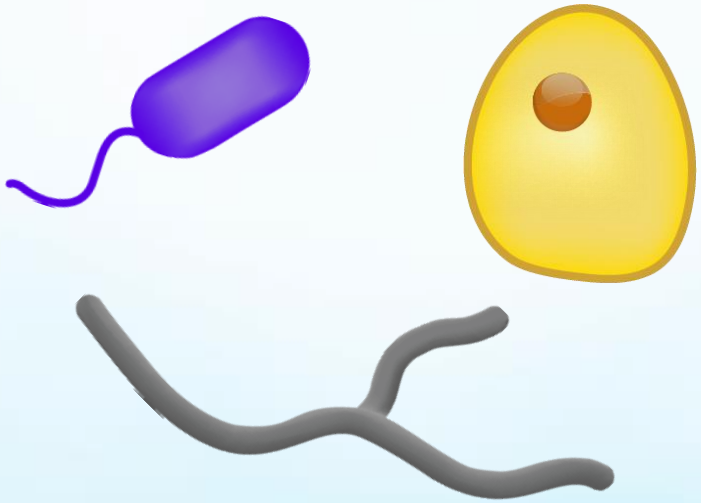
Bioextraction using microbes

Aim: concentrate and recover dissolved metals (Li, Sr, Cu, Au, Sb, Ag, Co) from geothermal brines.

Why microbes? **&** **Which microbes?**





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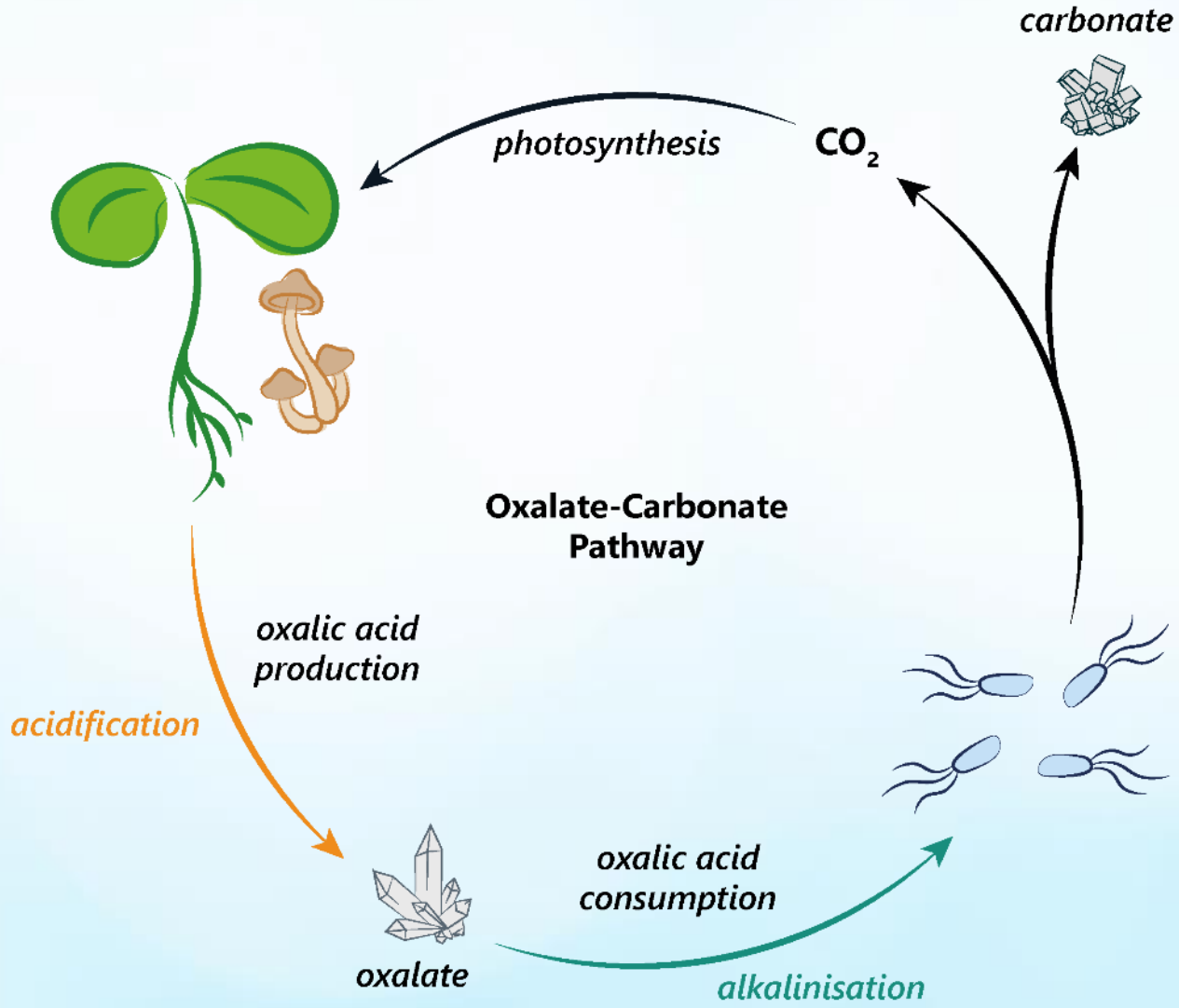
The oxalate-carbonate pathway (OCP)



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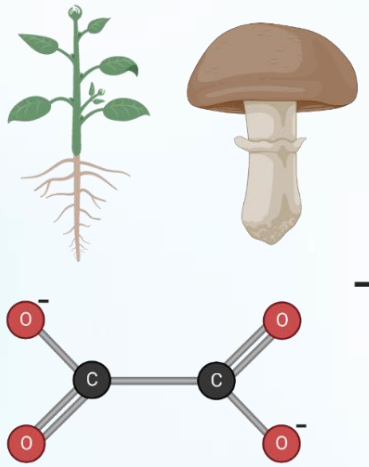
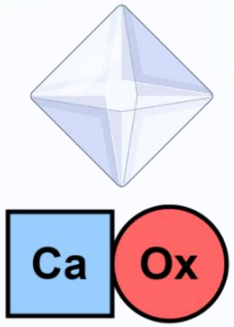
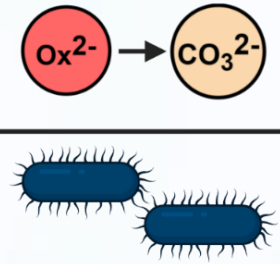
A nature-inspired process



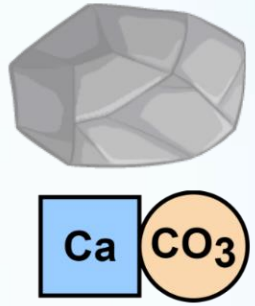
Plant roots and fungi
- Oxalate production (Ox)

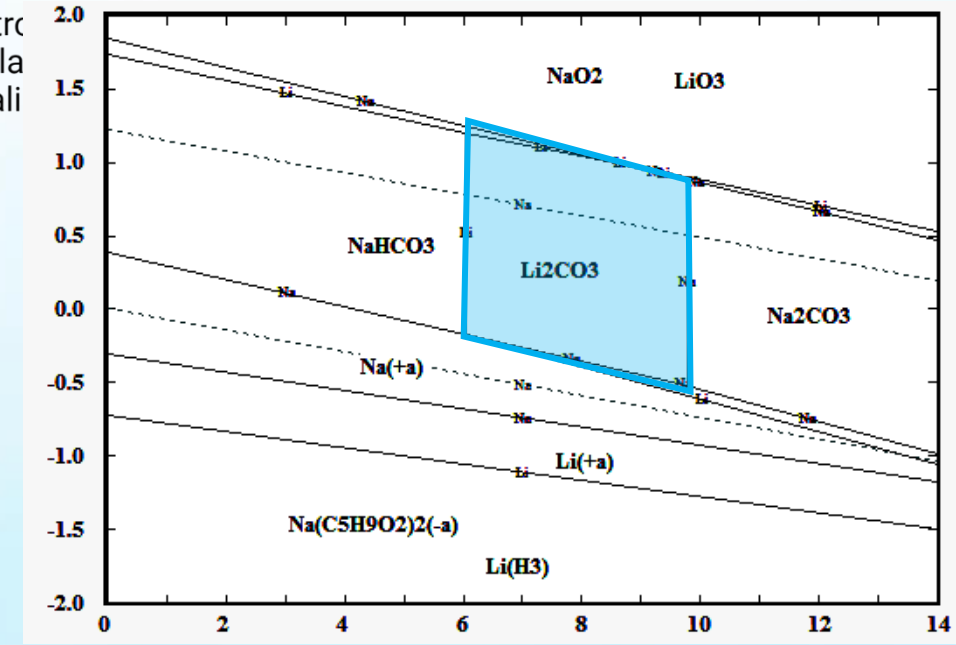


Calcium oxalate in soil



Oxalotro
- Oxala
- Alkali





Hypothesis: the OCP can be applied for metal recovery in the form of metal-carbonates

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Lithium biorecovery steps

MSc thesis Eliot Schmid
PhD thesis Guylian Laurent


Production of oxalic Acid (OxA)

1

Elemental filtering with oxalate

2

Lithium precipitation

3

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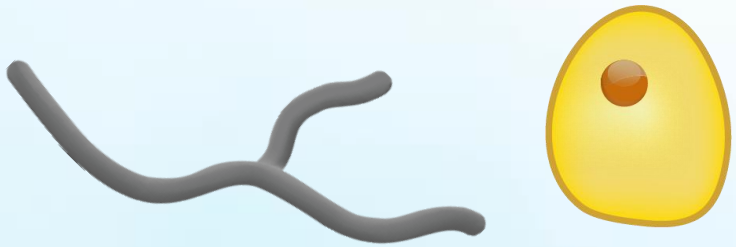
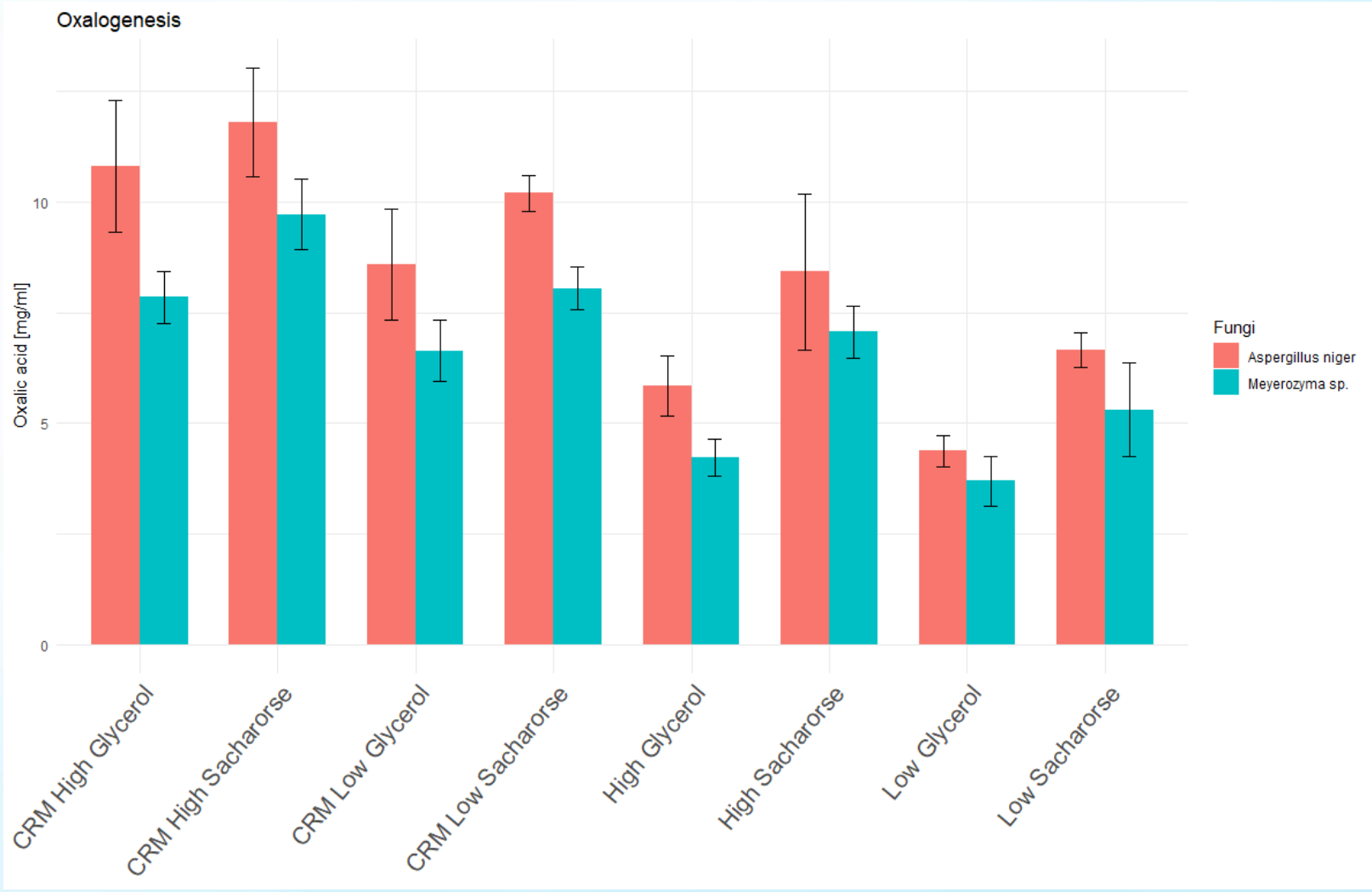
Step 1

Production of oxalic Acid (OxA)

- *Aspergillus niger*
- *Meyerozyma* sp.





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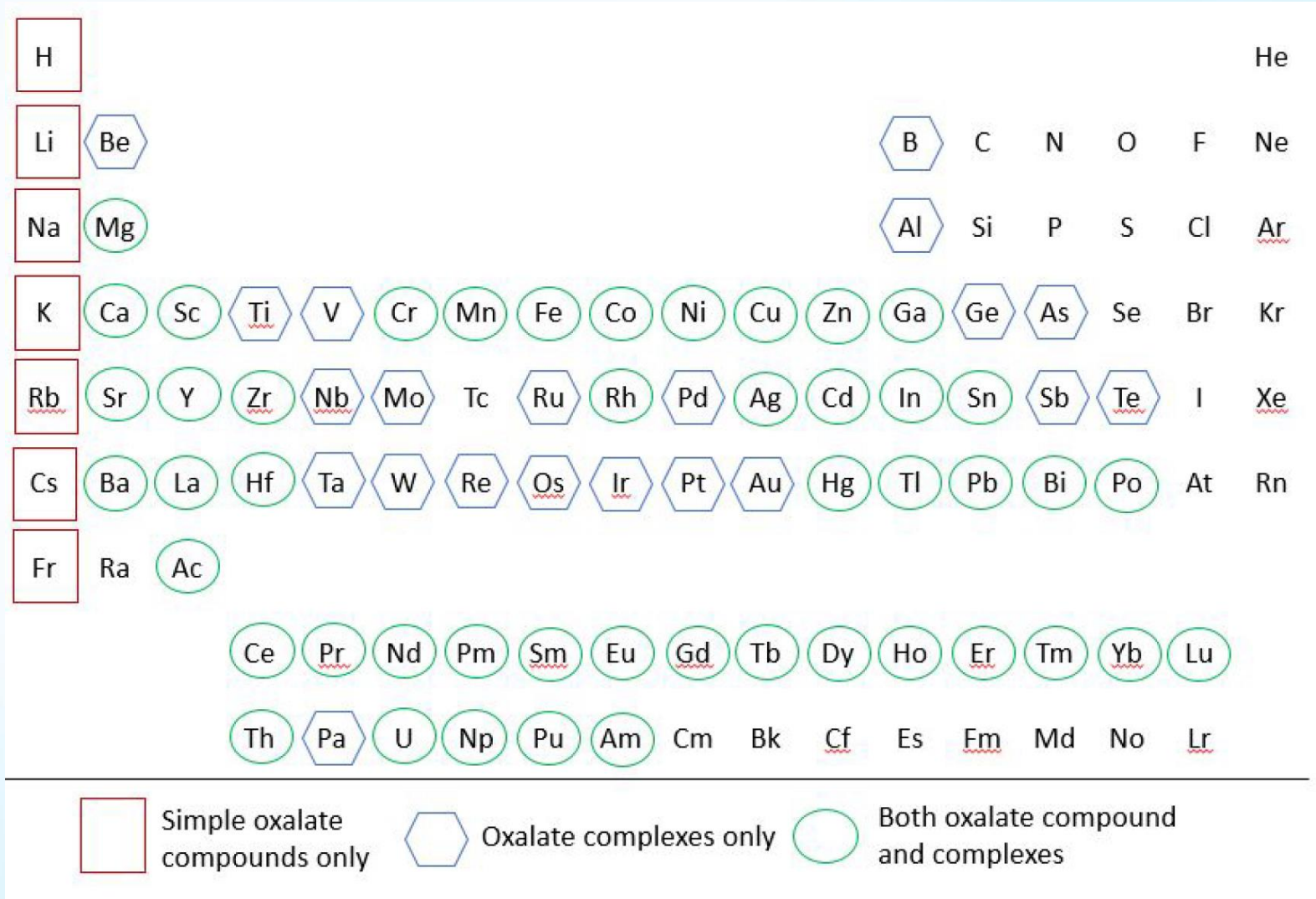
Step 2

Elemental filtering with oxalate

Most oxalate compounds are insoluble.

Exceptions are:

- $BeC_2O_4 \cdot 3H_2O$
- $CrC_2O_4 \cdot H_2O$
- $Fe_2(C_2O_4)3$
- **$Li_2C_2O_4$**
- $K2C_2O_4$
- $Na_2C_2O_4$
- $Ti_2(C_2O_4)_3 \cdot 10H_2O$
- VOC_2O_4



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Step 2

Elemental filtering with oxalate

Solubility in 100 mL H_2O:

- Li-Oxalate 6.6 g
- Ca-Oxalate 0,0006 g

Fluid characteristics

pH : 7,04

Alkalinity (as $CaCO_3$): 84,3

Temperature: 20-30 °C

[ppm]

Cl^-	SO_4^{2-}	Na^+
3010	33.8	1128
Ca^{2+}	K^+	Li^+
667	73.4	40

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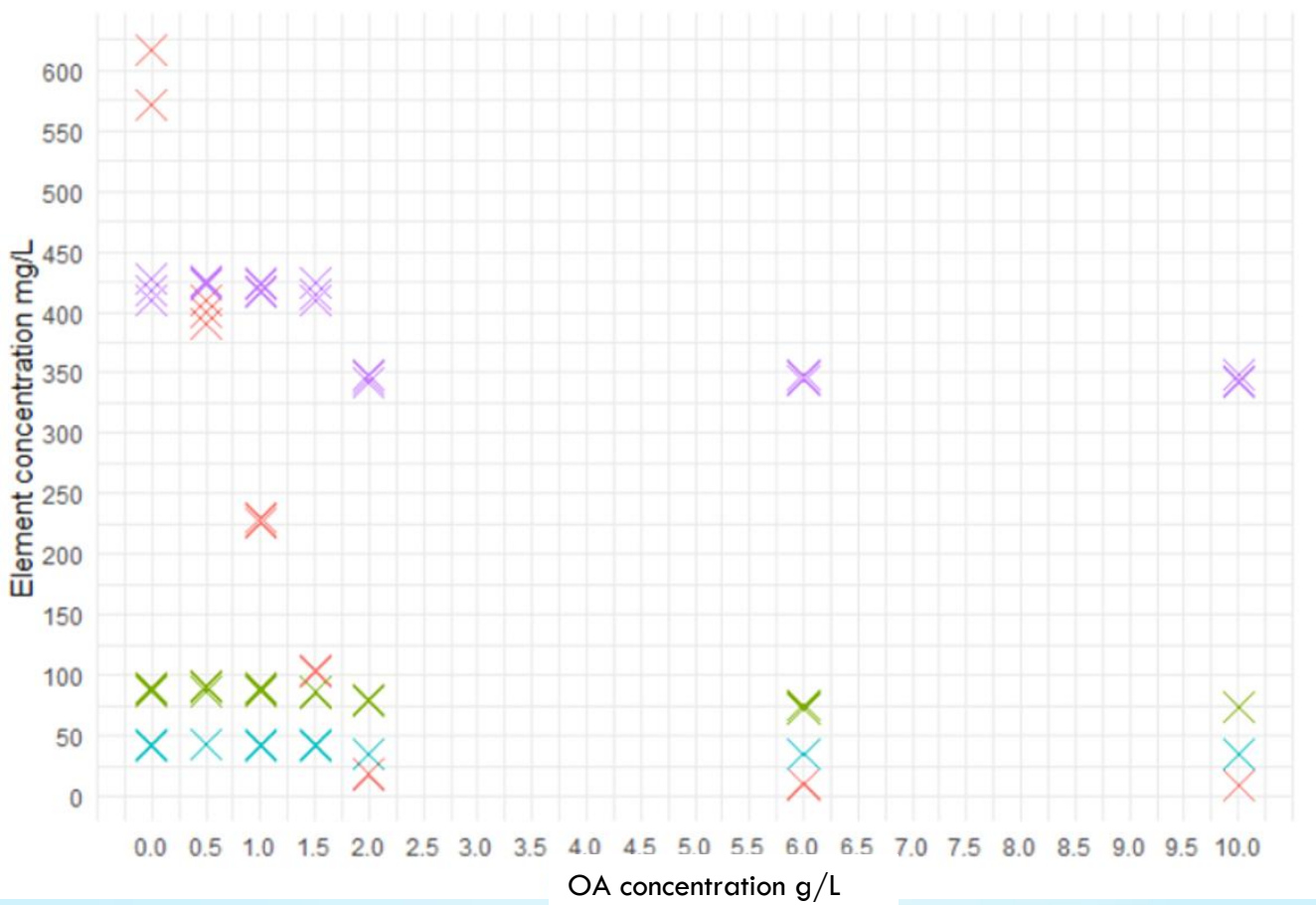
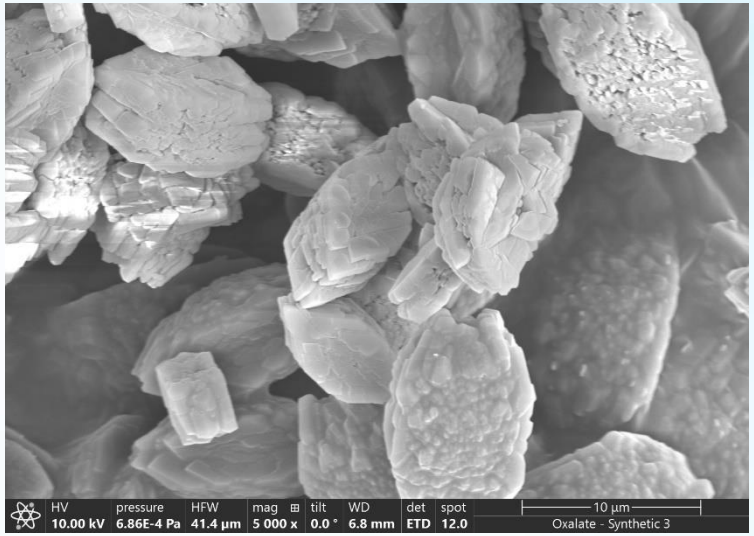
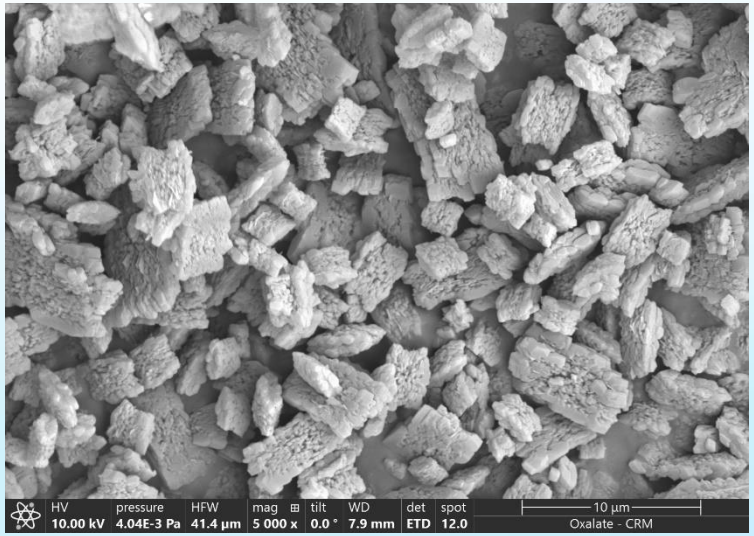
Step 2

Elemental filtering with oxalate





Synthetic fluid



CRM fluid

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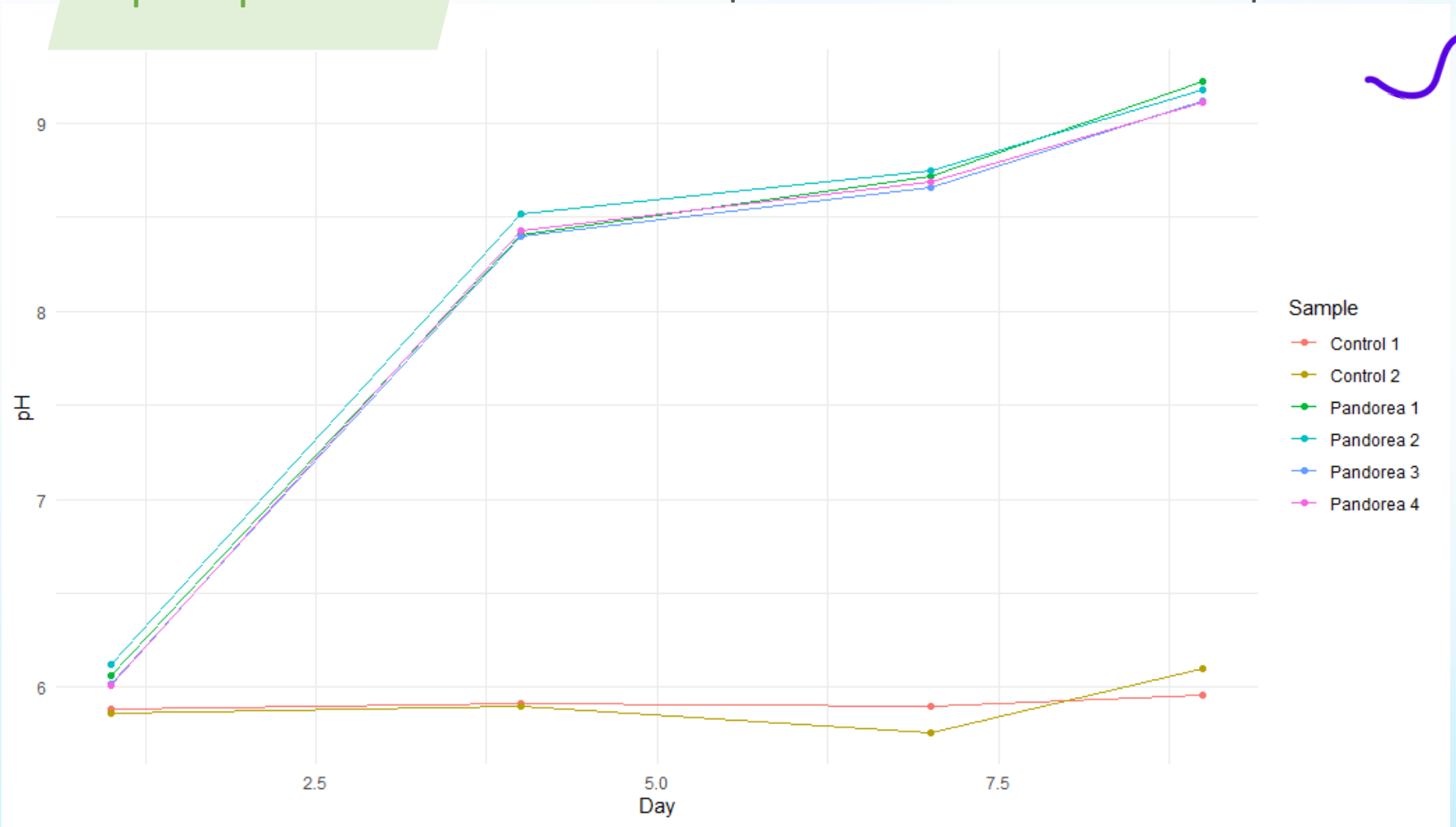
Step 3

Lithium precipitation

Oxalotrophic bacterium: *Pandoraea* sp.



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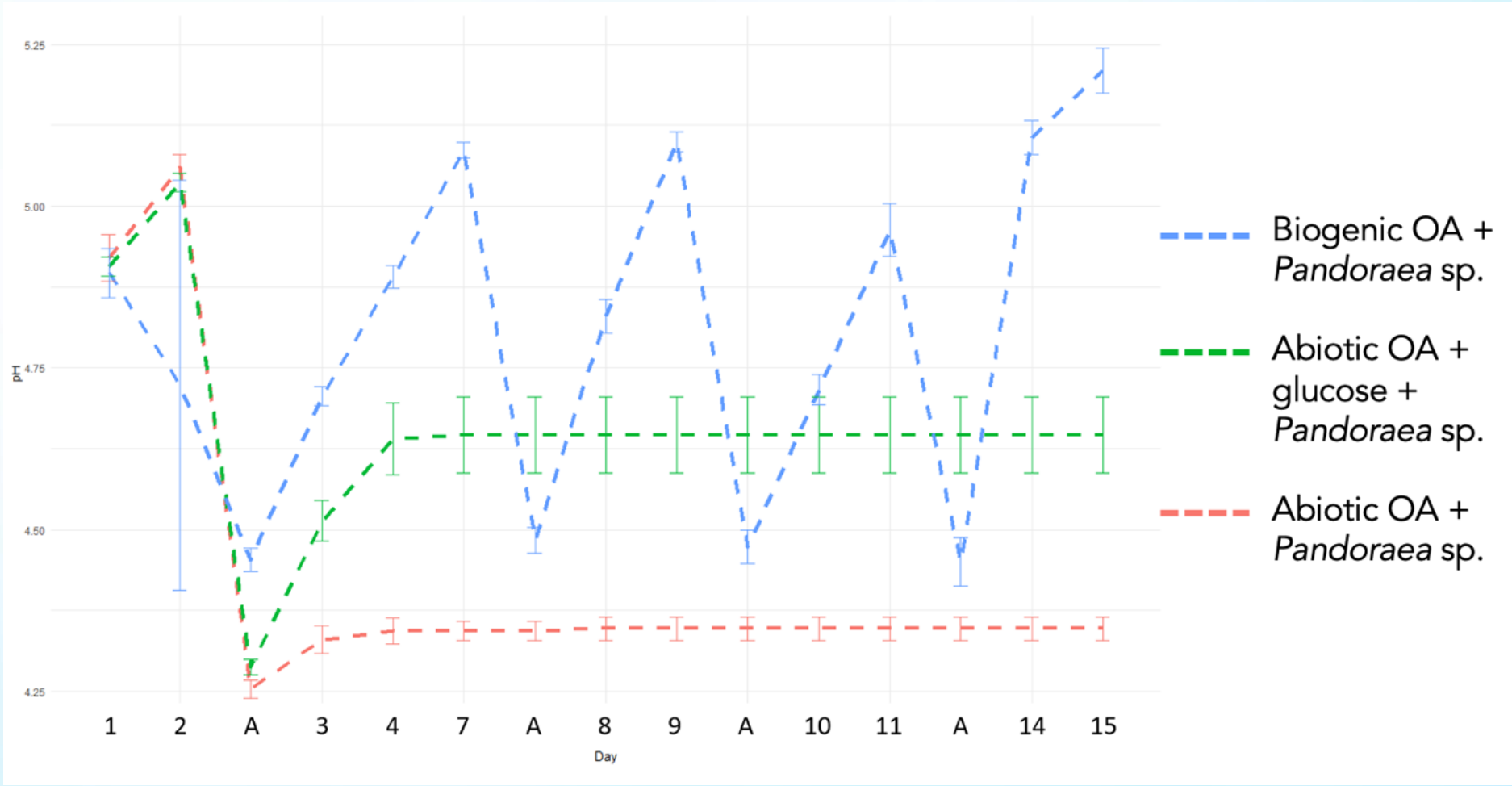
Step 3

Lithium precipitation

Pandoraea sp.



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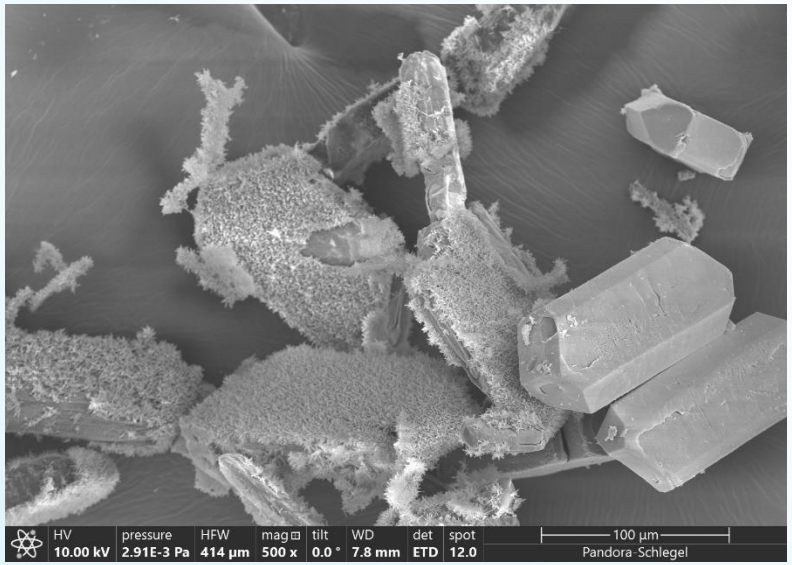
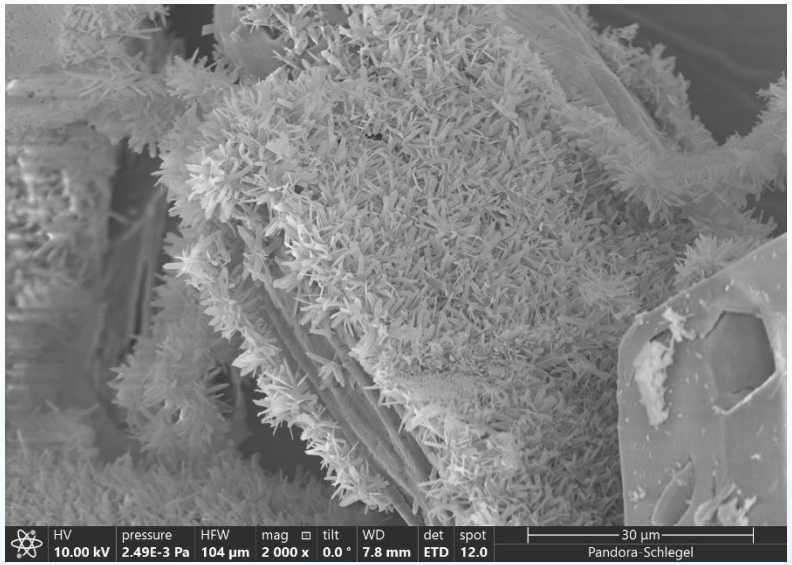
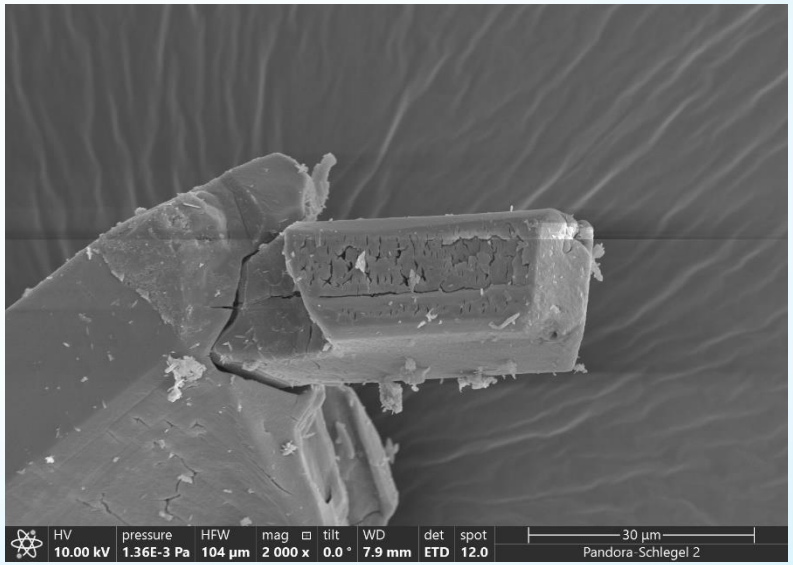
Lithium precipitation







Pandoraea sp. grown in optimal conditions with a synthetic fluid

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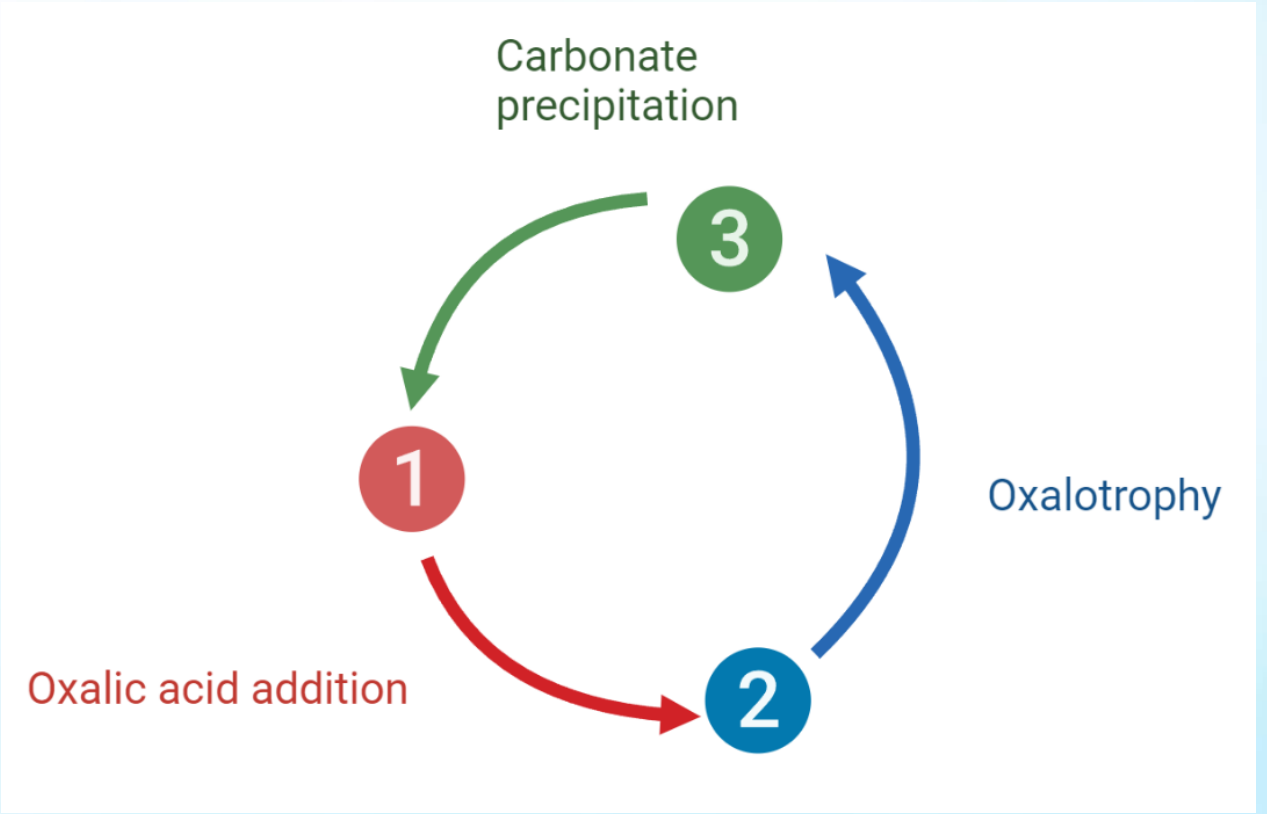
Summary

A microbial-driven process is realistic!

- Oxalic acid is easy to produce
- Most metal-oxalates are insoluble

Still to work on:

- Oxalotrophy and initial pH
- [Li] in fluids



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Thank you for your attention!

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All co-authors and project partners!

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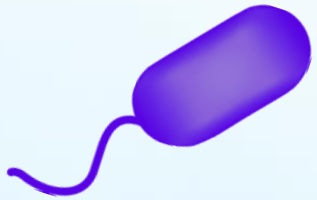
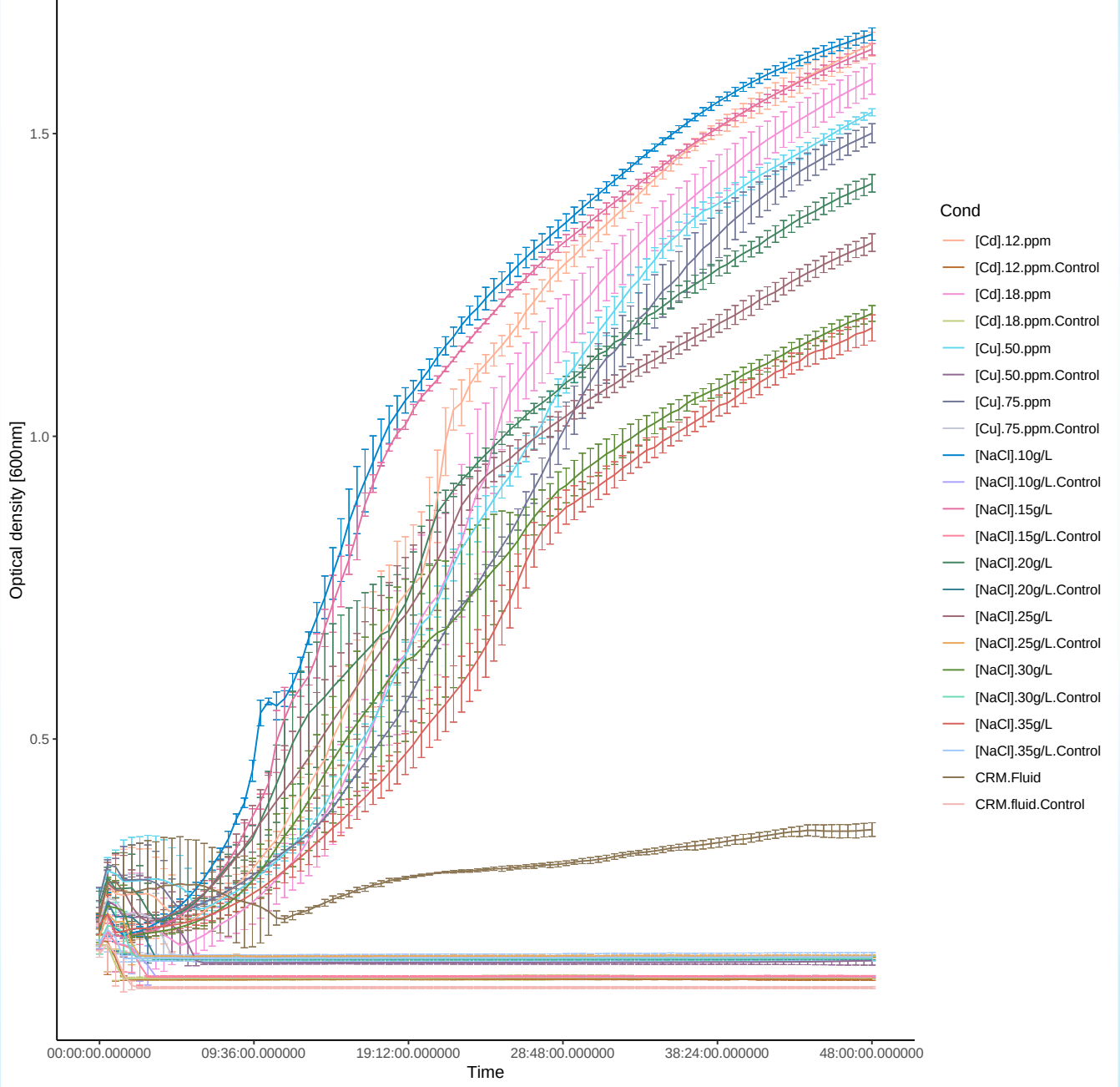
Cornish Lithium

Step 3

Lithium precipitation

Pandoraea sp.





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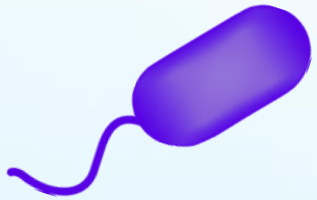
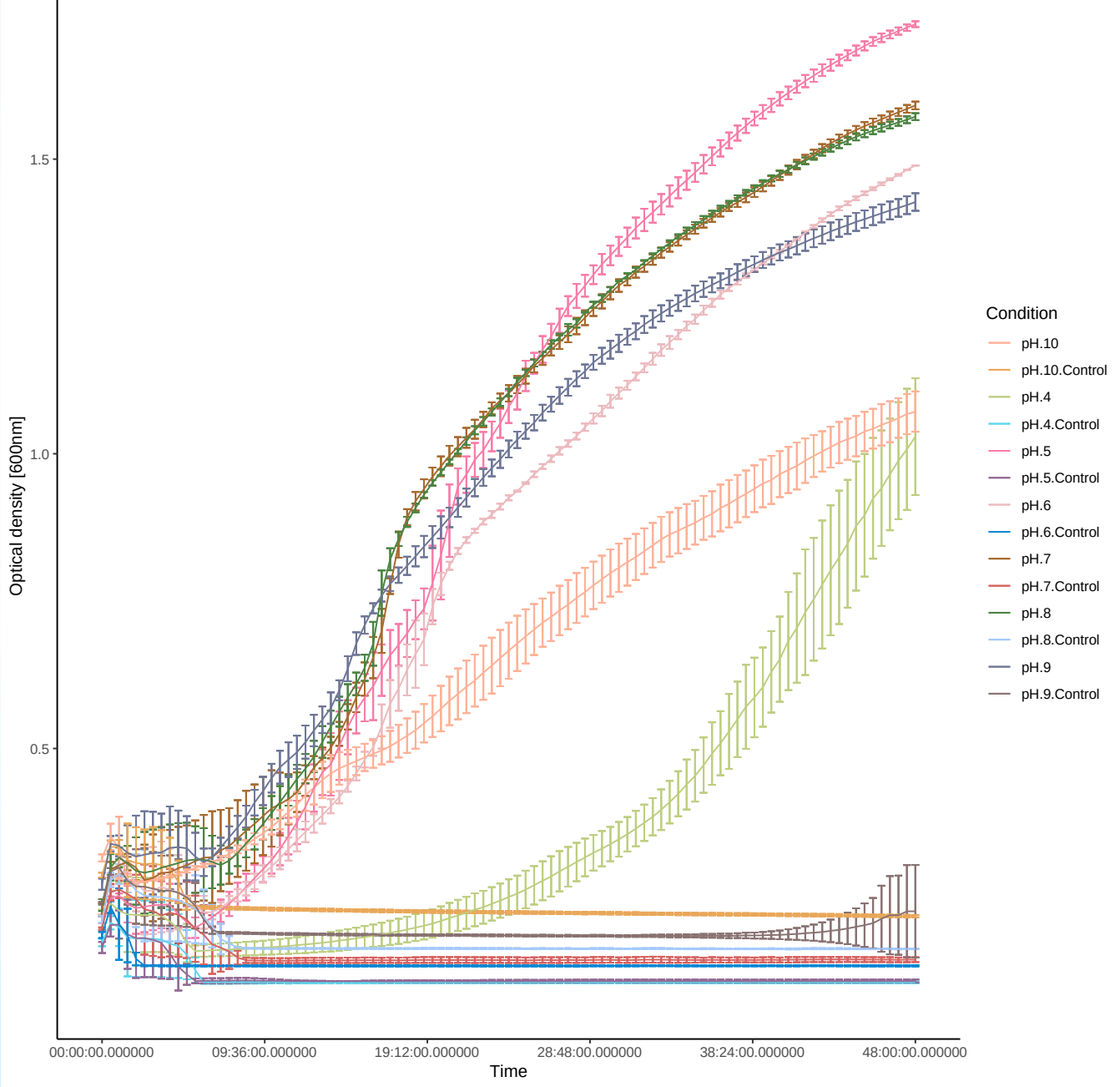
Lithium precipitation

Pandoraea sp.





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