

Biogas Enrichment by Integrating Olivine into Waste Treatment Facilities

“CO₂ mineral carbonation, a natural way to return carbon to the lithosphere”



Integrate into two-stage
wastewater treatment plants.



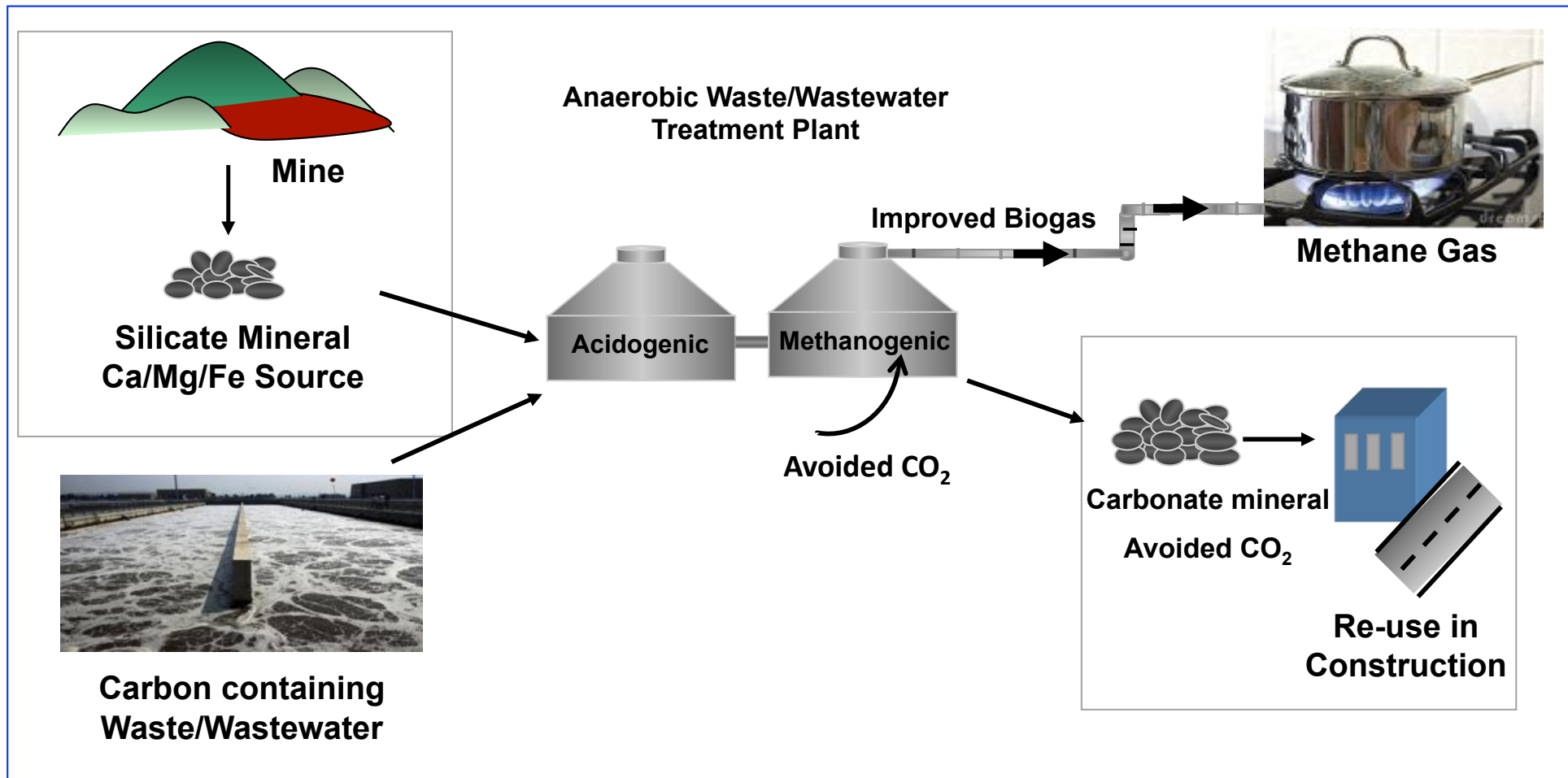
Two-stage wastewater treatment facilities:

- **Anaerobic digestion process**
- Nitrification and denitrification
- Desulfurization treatment
- Microbial fuel cells (MFCs)



Technological potentials:

Two-stage anaerobic digestion process



Added values to the system



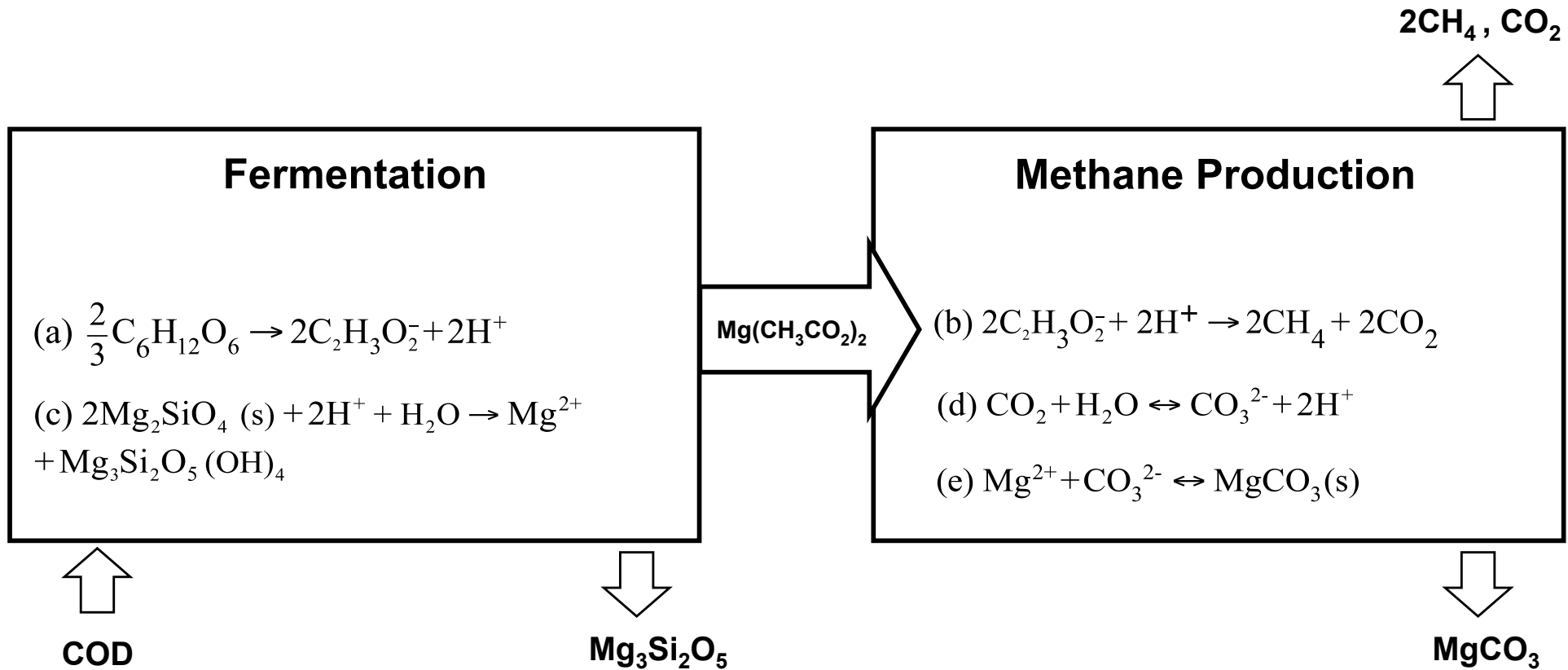
- **CO₂ carbonation → biogas with higher methane content.**

⇒ higher heat and power generation efficiency.
- **The iron in Olivine ((Fe,Mg)₂SiO₄) can facilitate mineralization of H₂S as ferrous sulphide (FeS) (wt.wt⁻¹) [1].**

⇒ Upgraded to Natural gas → Less impurities → Less Costs
- **Higher content of Mg-, Ca- or Fe-carbonate precipitates in the stabilized residues**

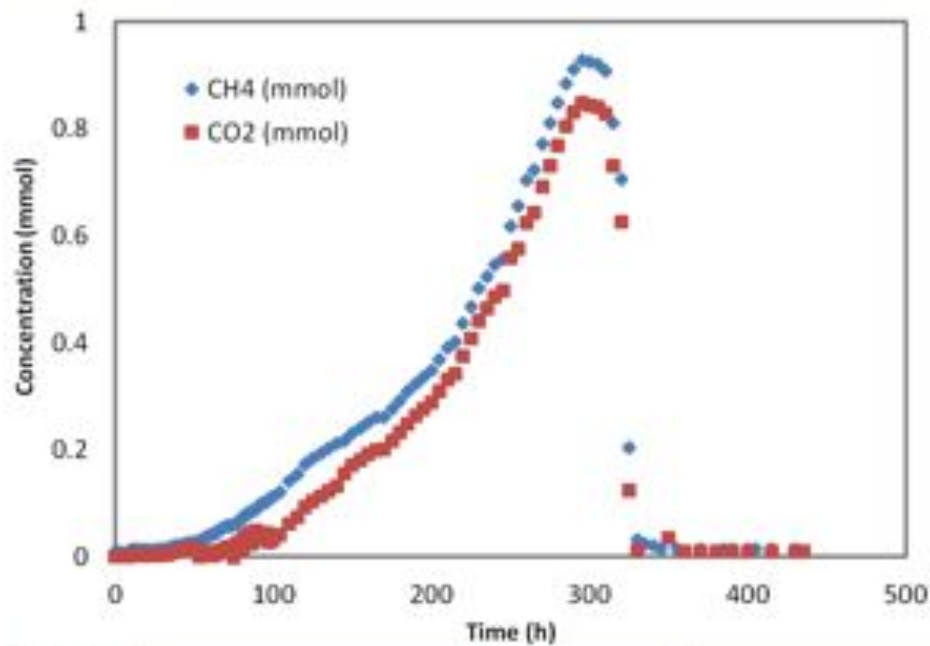
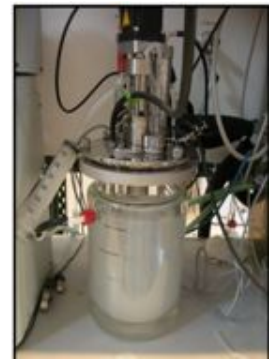
⇒ fertilizer with higher quality.

Two-stage anaerobic digestion process



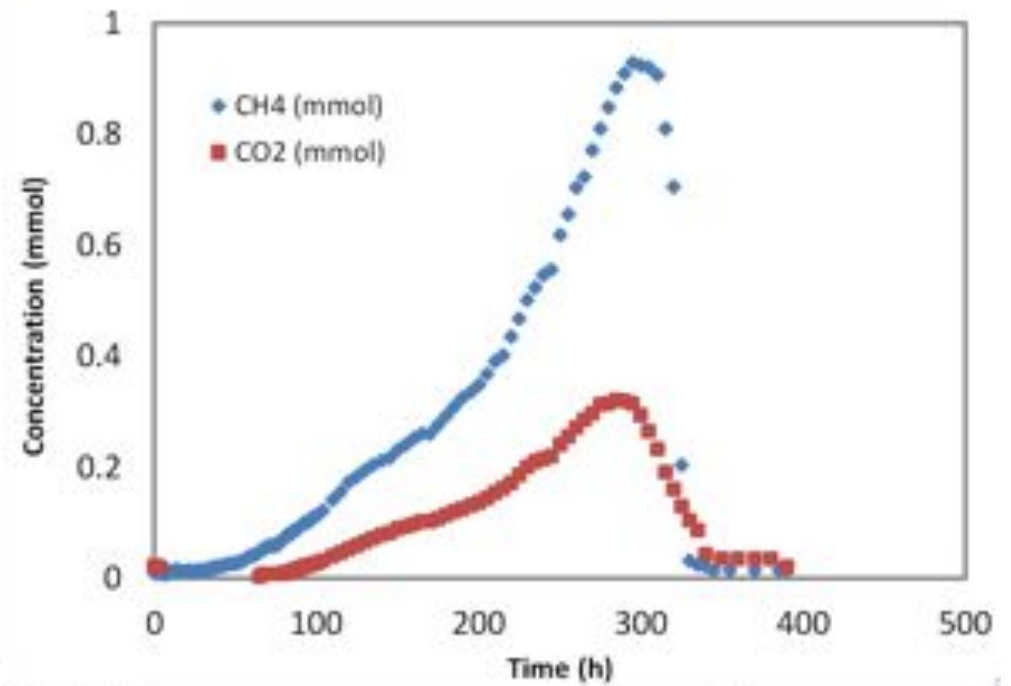
Experimental Results

Anearobic bio-reactor



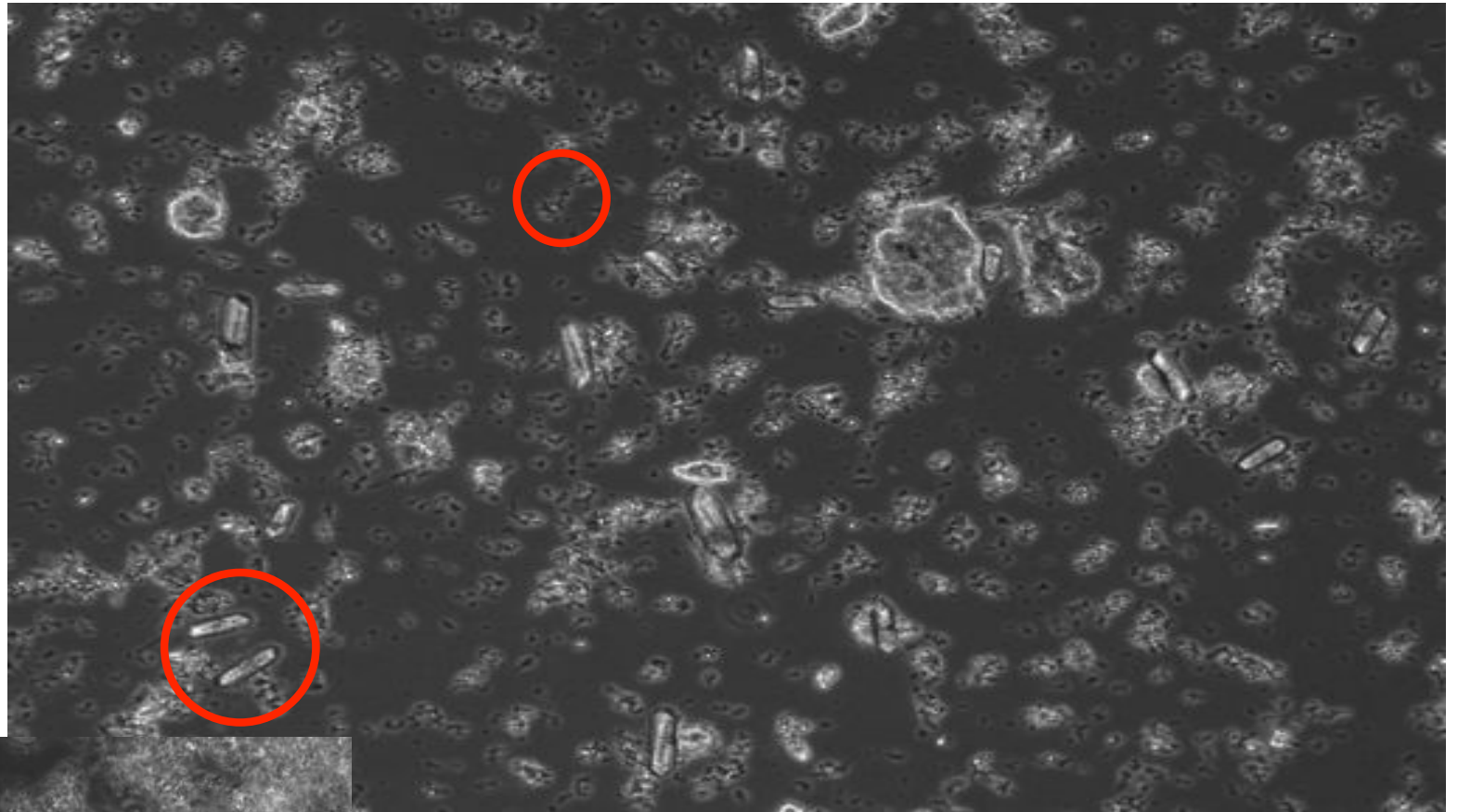
Olivine free bio-reactor

- 52 % CH₄
- 48 % CO₂



Bio-reactor with olivine

- 73 % CH₄
- 27 % CO₂

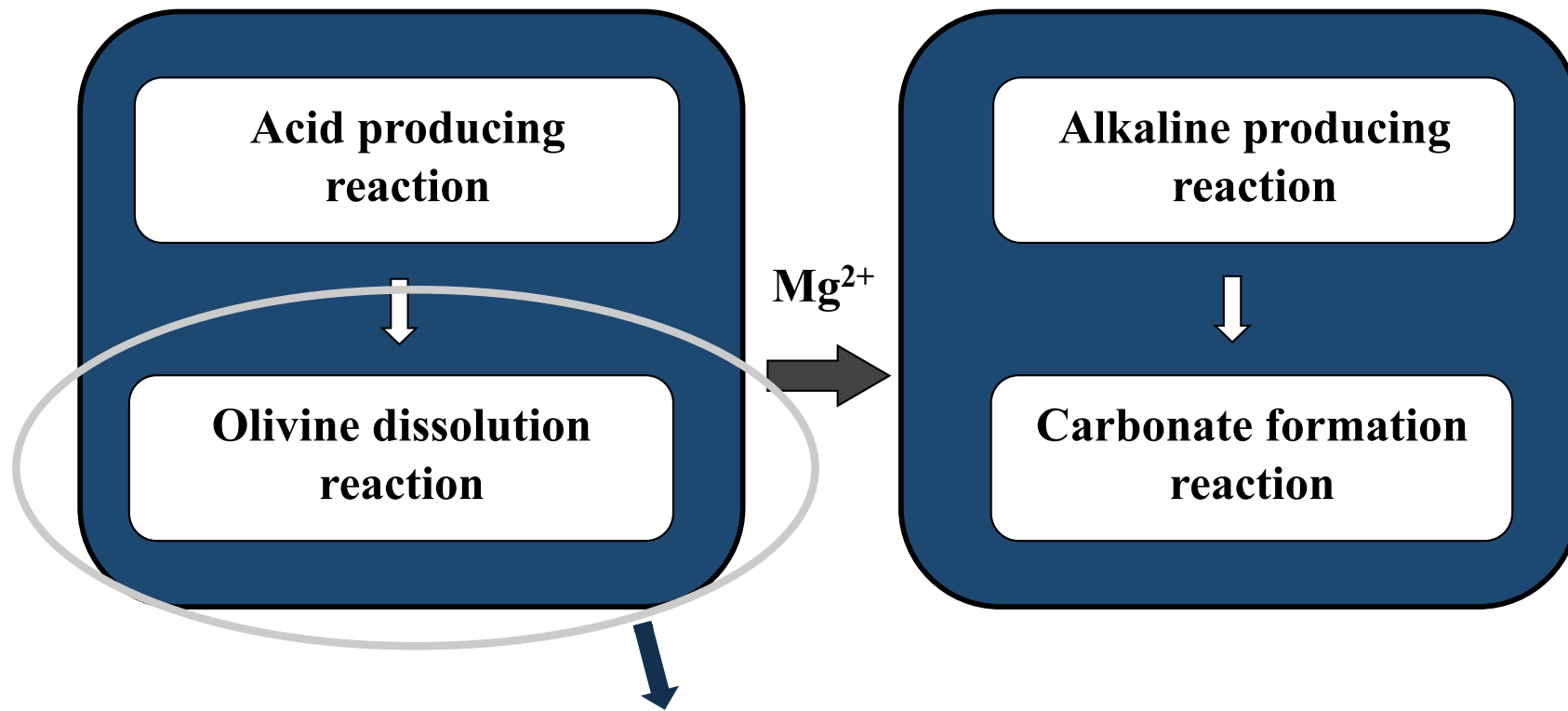


Precipitates in the bio-reactor

How to increase the CH₄ content?

- Higher CO₂ pressure
- Lower the K_{la} value
- **Higher Mg⁺² concentration → higher dissolution rate**

By applying these techniques we should be able to obtain CH₄ content up to 90-95 %

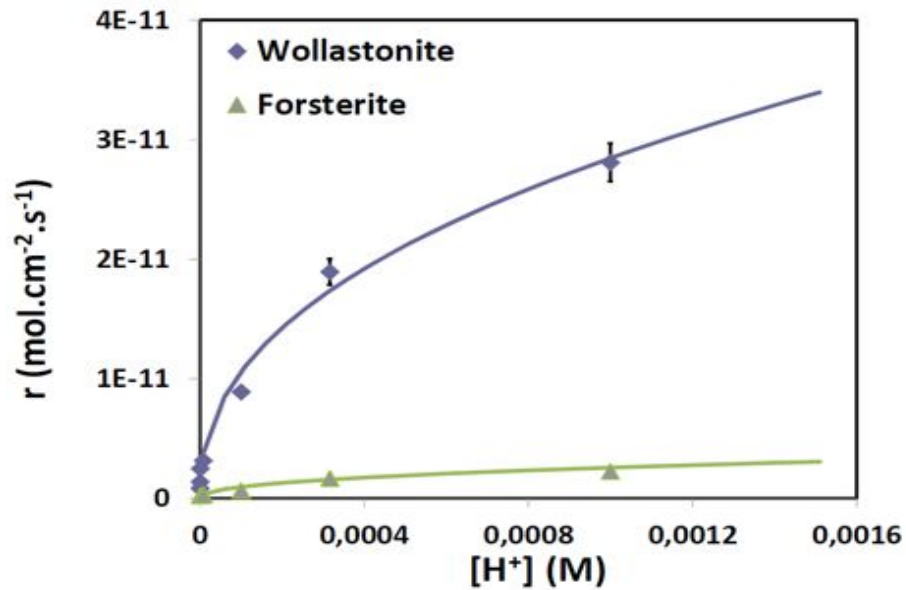
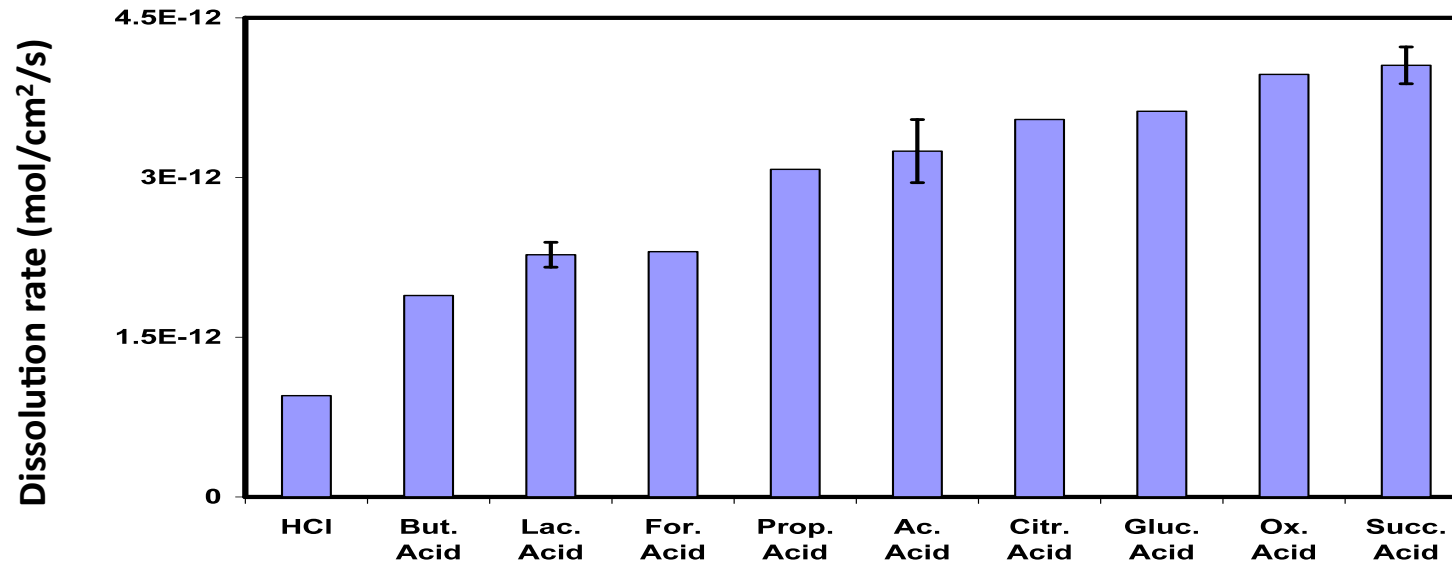


Rate determining process

- pH
- Biological products
- Temperature
- Substrate
- Direct microbial impacts

Impact on Olivine dissolution rate

Experimental Results





CO₂ Sequestration Potentials

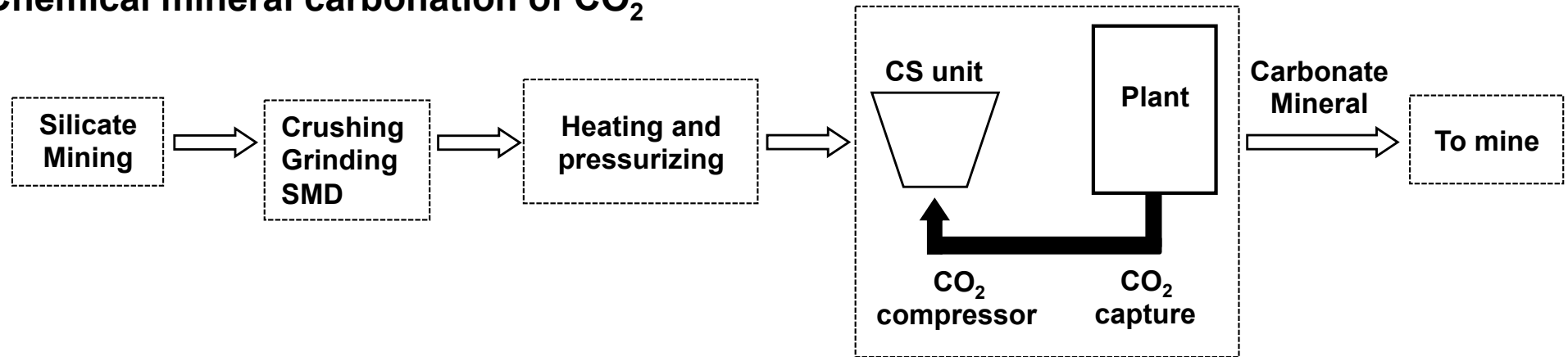
CO₂ Sequestration Potentials

Biodegradation of the organic carbon content of the solid waste generated globally each year by anaerobic digestion can sequester 1.5-2 % wt.wt⁻¹ of the total anthropogenic CO₂.

Cost Evaluation

- 102 €/ton CO₂ avoided → Chemical MC process [1]
- 40 € /ton CO₂ avoided → Proposed biological MC
(~ 60 % reduction)

Chemical mineral carbonation of CO₂



Biological mineral carbonation of CO₂

