Colloque EC2CO – 15 et 16 Avril 2025, Poitiers



Impact of matrix granulometry on the dehalogenation function of a microbial community

Impact de la granulométrie de la matrice sur la fonction de déshalogénation d'une communauté microbienne

Projet DéGra : 2022-2023

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Dichloromethane in the environment



Gg = thousands of tons

Dichloromethane in the environment





Microbial remediation of DCM in contaminated aquifers



Microbial remediation of DCM in contaminated aquifers



Response of the microbial community to environmental disturbances



Response of the microbial community to environmental disturbances



Water table fluctuations promote DCM biodegradation

Project 2D-DCM







95% DCM dissipation



Groundwater level fluctuations in the environment



Matrix granulometry controls water holding capacity in aquifers



Matrix granulometry controls water holding capacity in aquifers



Matrix granulometry controls water holding capacity in aquifers



11

Introduction

Research question

How are DCM biodegradation kinetics and bacterial community composition impacted by:

- a) Environmental conditions (water content, oxygen concentration and matrix granulometry)?
- b) Environmental disturbances (changes in oxygen concentration)?

Laboratory microcosms with different matrix granulometries



adapted to GC-MS-FID

Different types of laboratory microcosms



More development than initially thought!

Experimental design



- Monitoring of DCM concentration
- Microbial community analyses from DNA extracted at T0, T-bef and T-end

Experimental design



Daily measurments, directly from the gaz phase (no subsampling, no sacrifical strategy)



A word about controls

Abiotic controls (Sterilized inoculum)

- Quantification of DCM dissipation
- Stable oxygen concentrations

All changes in DCM concentration in B and E microcosms corresponded to **biotic degradation** **Biotic controls** (Sterilized inoculum + *Hyphomicrobium* sp. GJ21)

- DCM biodegradation under experimental conditions
- DCM degradation under both oxic and anoxic conditions

The experimental set-up **was compatible** with DCM biodegradation



DCM biodegradation with the 2.0 mm grain size matrix

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Optimal DCM biodegradation

		2.0 mm	0.5 mm	0.1 mm
	Oxygen status	Oxic		
Oxic Anoxic	Water content	WHC		



DCM biodegradation with the 2.0 mm grain size matrix







DCM biodegradation across matrix granulometries

• Optimal conditions in Environmental samples

	2.0 mm	0.5 mm	0.1 mm
Oxygen status	Oxic	Oxic	Охіс
Water content	WHC	½ WHC	½ WHC

- Oxic conditions promoted DCM biodegradation regardless of matrix granulometry
- The influence of water content was controlled by matrix granulometry



Comparison with the model strain Hyphomicrobium sp. GJ21

• Optimal conditions in Environmental samples

	2.0 mm	0.5 mm	0.1 mm
Oxygen status	Oxic	Oxic	Oxic
Water content	WHC	½ WHC	½ WHC

vs. Biotic controls (*Hyphomicrobium* sp. GJ21)

	2.0 mm	0.5 mm	0.1 mm
Oxygen status	Oxic/Anoxic	Oxic/Anoxic	Oxic/Anoxic
Water content	Saturation	WHC	Saturation

- Oxic conditions promoted DCM biodegradation regardless of matrix granulometry
- The influence of water content was controlled by matrix granulometry

- DCM biodegradation was observed under both
 oxic and anoxic conditions
- More sensitive to low water content than the environmental inoculum



DCM biodegradation with the 2.0 mm grain size matrix in response to a change in oxygen concentration



	Oxic to Anoxic	Anoxic to Oxic	
2.0 mm	Resistance/ Sensitivity	Latent functional diversity	
0.5 mm			
0.1 mm			





Response to a change in oxygen concentration across different matrix granulometries





Influence of a change in oxygen concentration on microbial community composition



The initial oxygen status had a **stronger impact** on microbial community composition



What is the impact of **water content** and **oxygen status** on a DCM degrading microbial community?

What is the response of a DCM degrading **microbial community** to a **change** in oxygen concentration?

General conclusions



Does **matrix granulometry** change the impact of water content and oxygen level on the DCM degrading community?

Grain size	
	WHC
O ₂ diffusion	



What is the response of a DCM degrading **microbial community** to a **change** in oxygen concentration?

General conclusions



Does **matrix granulometry** change the impact of water content and oxygen level on the DCM degrading community?

Grain size	
	WHC
O ₂ diffusion	



What is the response of a DCM degrading **microbial community** to a **change** in oxygen concentration?

General conclusions





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General conclusions













General conclusions



30

On the EC2CO funding programme

• Perfect combinaison with PhD grant from the doctoral school

On the EC2CO funding programme

- Perfect combinaison with PhD grant from the doctoral school
- Preliminary data help with ANR JCJC (MINI2BIO: jan 2025-june 2028)
- WP2 Put forward measurable ecological niche descriptors, or sets of descriptors that explain the response of the targeted bioremediation function to disturbance



Thank you for your attention !



CNIS





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Fundings

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