



**HAL**  
open science

## Deep underground methanogenesis for recycling CO<sub>2</sub>

Emeline Vidal, Anaïs Cario, Cyrielle Fauveau, Carole Lecoutre, Yves Garrabos, Olivier Nguyen, Anthony Ranchou-Peyruse, Samuel Marre

► **To cite this version:**

Emeline Vidal, Anaïs Cario, Cyrielle Fauveau, Carole Lecoutre, Yves Garrabos, et al.. Deep underground methanogenesis for recycling CO<sub>2</sub>. 18th European Meeting on Supercritical Fluids, International Society for the Advancement of Supercritical Fluids, May 2021, Visioconférence, France. pp.1-2. hal-04595637

**HAL Id: hal-04595637**

**<https://hal.science/hal-04595637>**

Submitted on 31 May 2024

**HAL** is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.



# 18<sup>th</sup> European Meeting on Supercritical fluids

May 4<sup>th</sup>-6<sup>th</sup>, 2021 - ONLINE



International society for the advancement of supercritical fluids

## PROCEEDINGS

### CONFERENCE SCOPE

The objective of the meeting is to gather together all the members of the supercritical fluid community and to give the opportunity to academic researchers and industrial practitioners to provide a complete and critical up-date on all the current technologies using Supercritical Fluids, their different applications as well as the latest innovations being developed.



[INVITED](#)

[KEYNOTES](#)

[ORALS](#)

[POSTERS](#)

## Deep underground methanogenesis for recycling CO<sub>2</sub>

Emeline Vidal,<sup>a</sup> Anaïs Cario,<sup>a</sup> Cyrielle Fauveau,<sup>a</sup> Carole Lecoutre<sup>a</sup>, Yves Garrabos,<sup>a</sup> Olivier Nguyen,<sup>a</sup> Anthony Ranchou-Peyruse,<sup>b</sup> and Samuel Marre\*<sup>a</sup>

<sup>a</sup> CNRS, Univ. Bordeaux, Bordeaux INP, ICMCB, F-33600, Pessac cedex, France.

<sup>b</sup> Université de Pau et des Pays de l'Adour, E2S UPPA, IPREM, Institut des Sciences Analytiques et de Physico-Chimie pour l'Environnement et les Matériaux, Pau, France.

The dramatic increase of anthropogenic greenhouse gases concentrations in the atmosphere threatens the ecosystems equilibrium, including our way of life. The development of sustainable technologies in the frame of mitigation efforts to reduce anthropogenic CO<sub>2</sub> emissions remains an urgent need. A promising strategy consists in storing the CO<sub>2</sub> in deep geological formations, like deep saline aquifers, where it could be used as a raw material by endemic microbes. Far from being anecdotal, the transformation of part of the stored CO<sub>2</sub> into methane would lower the costs of capture and storage.

Deep saline aquifers are porous environments, with temperature ranging between 40°C to 100°C and hydrostatic pressure up to 150 bar. Methanogens, and more particularly hydrogenotrophic methanogens, which can transform CO<sub>2</sub> and H<sub>2</sub> into methane (CO<sub>2</sub> + 4 H<sub>2</sub> → CH<sub>4</sub> + 2 H<sub>2</sub>O), are part of the microbial population living in such environments. Using their metabolisms would allow considering deep saline aquifers as macro bioreactors for an upgrading process of CO<sub>2</sub> to methane (Fig. 1)<sup>(1)</sup>. However, little is known about their response to a high CO<sub>2</sub> injection<sup>(2)</sup>. Therefore, we are investigating in here methanogenesis reaction in these conditions, with a model strain, *Methanococcus thermolithotrophicus*<sup>(3)</sup>, in order to determine the key parameters to improve the CO<sub>2</sub> recycling potential. We have developed multiscale high pressure approaches (microfluidics<sup>(4)</sup> and millifluidics) to investigate this biochemical reaction at lab scale, allowing to mimic deep environments.

The tools and approaches that we are developing and using will make it possible to simulate these deep ecosystems, to estimate the yields of such approaches and the possibility of testing exploitation scenarios.



Figure 1: Deep underground CO<sub>2</sub> bioconversion

**Acknowledgments:** This project has received funding from the European Research Council (ERC) under the European Union's Horizon 2020 research and innovation program under grant agreement No 725100.

1. <https://www.erc-bigmac.cnrs.fr/>
2. Ranchou- Peyruse M, Auguet JC, Mazière C, Restrepo- Ortiz CX, Guignard M, Dequidt D, Chiquet P, Cézac P, Ranchou- Peyruse A. 2019. Geological gas- storage shapes deep life. *Environmental microbiology* 21:3953-3964.
3. Huber H, Thomm M, König H, Thies G, Stetter KO. 1982. *Methanococcus thermolithotrophicus*, a novel thermophilic lithotrophic methanogen. *Archives of Microbiology* 132:47-50.
4. Morais S, Liu N, Diouf A, Bernard D, Lecoutre C, Garrabos Y, Marre S. 2016. Monitoring CO<sub>2</sub> invasion processes at the pore scale using geological labs on chip. *Lab on a Chip*, 2016. 18:3493-3502.