A-160

Microbial risk assessment for underground hydrogen storage in Europe - EU project HyLife

P. Bombach[1], A.-S. Biwen[2], K. Cerna[3], J. Riha[3], V. Hlavackova[3], K. Fadrhonc[3], N. Paltrinieri[4], K. Kyaw[4], A. Oust[4], S. Rad[5], S. Stephant[5], M. Caroline[5], D. Ropers[6], A. Belcour[6], H. de Jong[6], J. Tremosa[7], N. Dopffel[2]
[1]Isodetect GmbH, Leipzig, Germany, [2]Norce, Bergen, Norway, [3]Technical University of Liberec, Liberec, Czech Republic, [4]Norwegian University of Science and Technology, Trondheim, Norway, [5]French Geological Survey BRGM, Orléans, France, [6]Inria, Grenoble, France, [7]Geostock, Ruel-Malmaison, France

Underground storage of green hydrogen (H_2) offers a promising approach to balance the fluctuating supply of renewable energy generation and demand. Excess electricity from wind and solar farms is converted to H_2 through electrolysis and stored in geological formations such as porous rock reservoirs and salt caverns for later use. H_2 is not only an environmentally friendly energy carrier but also a favorable energy source for microorganisms. Geological formations are colonized by a range of microorganisms [Ref03] which can use H_2 as an energy source [Ref01], which may have important implications for H_2 storage. In principle, microbial H_2 consumption can be coupled to the reduction of nitrate, ferric iron, sulphate, elemental sulfur or carbon dioxide) to produce nitrogen, ferrous iron, hydrogen sulfide, acetate or methane (figure 1, right side). Such microbial activities can induce a variety of microbial-triggered risks: a) loss of the stored H_2 and changes in gas composition, b) risks to operational safety and deterioration in quality by H_2S formation, c) damage of the technical equipment by biocorrosion and microbial triggered precipitates, d) changes of the reservoir properties by biofilm formation and precipitates [Ref02].

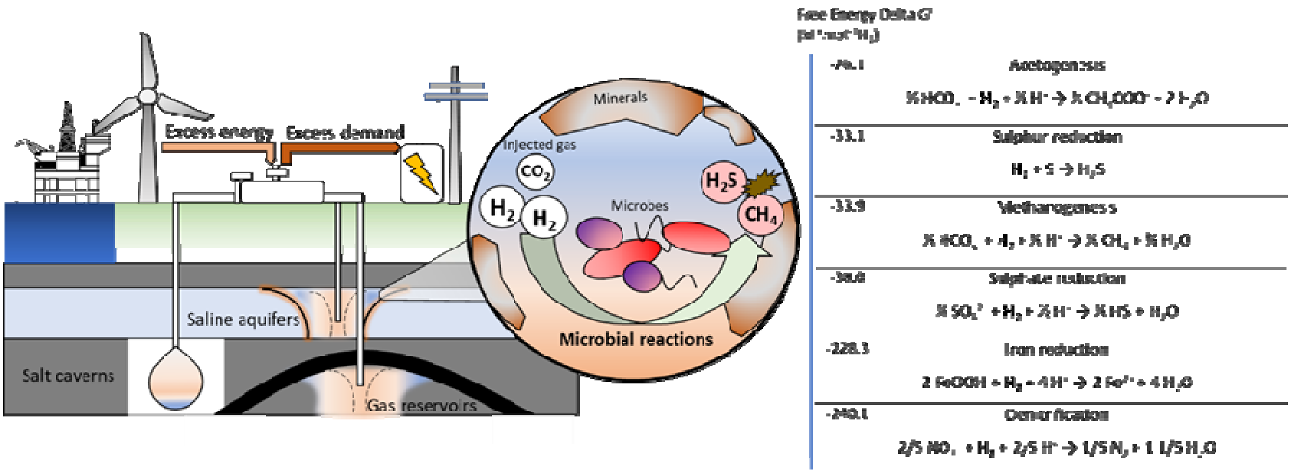

Figure 1 Overview of the concept of inter-seasonal subsurface energy storage. Excess energy is used to produce energy carriers like H2, which are injected into subsurface structures (salt caverns, gas reservoirs). The injected H2 can be used as electron donor by different microbial metabolisms (shown at the right). Figure by Nicole Dopffel (NORCE).

The CETP-sponsored R&D project HyLife aims to validate the suitability of European subsurface structures (salt caverns, porous reservoirs) as safe and economically viable H_2 storage sites by systematically investigating the potential microbial reactions and identifying key influencing parameters. Numerous potential storage sites are sampled to characterize the microbial community structure and H_2-consuming activity of the different samples. All obtained microbial data are linked to the local geochemical and geophysical conditions to fully assess the microbial risks associated with underground H_2 storage in Europe. With this we hope to find key factors for selecting sites and make safe and resilient H_2 storage in the subsurface possible.

Acknowledgement:

This research was funded by CETPartnership, the European Partnership under Joint Call 2022 for research proposals, co-funded by the European Commission (GA N°101069750) and with the funding organisations of Norway, France and Czech Republic listed on the CETPartnership website. In addition, this project is co-financed with tax revenue on the basis of the budget adopted by the Saxon state parliament. We also thank our industry partners Lanxess, BP, Total Energies, SLB, Corronation and OMV for their support.

References:

[Ref01] Dohrmann A.B., Krüger M., (2023), Microbial H2 consumption by a formation fluid from a natural gas field at high-pressure conditions relevant for underground H2 storage, Environmental Science & Technology, 1092-1102, 57(2)

[Ref02] Dopffel N., Jansen S., Gerritse J., (2021), Microbial side effects of underground hydrogen storage–Knowledge gaps, risks and opportunities for successful implementation, International Journal of Hydrogen Energy, 8594-8606, 46(12)

[Ref03] Schwab L., Popp D., Nowack G., Bombach P., Vogt C., Richnow, H.H., (2022), Structural analysis of microbiomes from salt caverns used for underground gas storage, International Journal of Hydrogen Energy, 20684-20694, 47(47)