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Autoclave experiments on autotrophic metabolism under elevated pressure and temperature by microbes from a mature German natural gas field

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The global need for energy is met with fossil fuel Power plants on a large scale. Industry with high energy consumption will also de-pend on fossil fuels for the next decades. Al-though scientists discuss the degree of the in-fluence of CO2 on green house processes, the effect itself is common accepted. Carbon cap-ture and storage (CCS) provides an approach to reduce emission by injecting CO2 from local sources into deep geologic formations instead of releasing it to the atmosphere.
Mature and depleted natural gas fields are un-der investigation as potential storage sites. Their proven tightness against gases over geo-logical time scales, their good or even excel-lent exploration and their already available infrastructure put them into the field of interest for scientists and industry.
The investigated natural gas field is operated by GdF SUEZ and is located north west of Hannover. The chemical and microbiological conditions are under investigation since the BMBF Project RECOBIO started in 2005.
The well chosen for further investigation be-cause of its high cell density found for sam-pled formation water (Ehinger et al. 2009), was characterized by a relative low salinity of 30 g/L and a high concentration of sulphate of up to 1200 mg/L
During three consecutive experiments, pro-duced formation water from the well was transferred into high-pressure, high-temper¬ature reactors (Berghof HB 500, HR 300) in combination with powdered and sterilized rock material from drilling cores of the site. All experiments where conducted in comparison to sterilized control reactors to distinguish be-tween microbial processes and chemical reac-tions.
After the addition of CO2 and H2 with total pressure of up to 18 bar at 40°C, microbial activity was observed by a decrease in H2 and CO2 concentration in the gas phase and a de-crease in sulphate concentration in the liquid phase. CO2 and H2 were depleted from the gas phase and were added frequently. Sulphate concentration started to decrease after 20 to 50 days, in some experiments until depletion. The addition of new sulphate rich produced forma-tion water led to a restart of sulphate reduc-tion. Sulphide concentrations of up to 70 mg/L where measured.
The most significant process of microbial activity was the formation of or-ganic compounds in the liquid phase. The composition of the organic compounds is still under investigation. First results are also pre-sented at this conference. (Kassahun et. al. 2011)
The concentration of methane was less than 1% in all experiments.
The influence of sulphide and the organic sub-stances on the formation rock material, regard-ing dissolution and precipitation are still under investigation. These experiments contribute to our knowledge and understanding of deep mi-crobial biocenosis, possible effects during CCS and the complex interactions between chemical and microbiological processes after injection.

References

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