Geophysical Research Abstracts
Vol. 13, EGU2011-13345, 2011
EGU General Assembly 2011

Microbial influence on mineral creation in carbon capture and storage (CCS) procedures

Monika Kasina (1), Anne Kleyböcker (1), Daria Morozova (1), Marietta Liebrich (1), Maren Wandrey (2), and Hilke Würdemann (1)

(1) Helmholtz Centre Potsdam GFZ, German Research Centre for Geosciences, International Centre for Geothermal Research, Telegrafenberg, 14473 Potsdam, Germany (kasina@gfz-potsdam.de), (2) Helmholtz Centre Potsdam GFZ, German Research Centre for Geosciences, Centre for CO2 storage, Telegrafenberg, 14473 Potsdam, Germany

Global climate changes connected with increasing emissions of CO_2 into atmosphere require the development of different carbon capture and storage (CCS) methods. One of the CCS methods is mineral carbonation that relays on crystallization of stable carbonate minerals rich in divalent cations (Ca^{2+}, Mg^{2+}, Fe^{2+}) with CO_2, which is one of the safest methods in CO_2 storage. Composition and activity of microbial communities that change due to CO_2 injection can influence mineral dissolution and precipitation processes. In this study we focus on microbial induced mineral formation. Microbial induced mineral creation was studied in an artificial system characterized by high concentrations of organic material (volatile fatty acid: 8000 mg l^{-1}) and high concentrations of Ca^{2+} (200 mg l^{-1}), Mg^{2+} (130 mg l^{-1}) and PO_4^{3-} (1000 mg l^{-1}) to better understand the processes and the role of microorganisms. During laboratory experiments different aggregates were produced depending on the concentration of divalent cations. The size of aggregates depended on the concentration of Ca^{2+}. Different minerals as well as organic matter were detected in the aggregates and supplied first evidence of the mechanism of mineral creation processes in these systems indicating the involvement of phosphate accumulating bacteria. Small aggregates (ca. 2 cm diameter) were formed as irregular spheres with a central nucleus. The nucleus was made of organic matter mixed with crystalline phases like vivianite ($Fe_3(PO_4)_2 \cdot 8H_2O$), k-feldspar ($KAlSi_3O_8$), plagioclases ($NaAlSi_3O_8$ - $CaAl_2Si_2O_8$), quartz (SiO_2) surrounded by layers (characteristic lamination) composed of organic acids (long chain fatty acids - LCFA which bond Ca (Al) or Ca (Mg, Fe) - LCFA - Ca, aluminum phosphate ($AlPO_4$). Bigger aggregates (ca. 10 cm diameter) were created in the presence of high Ca^{2+} concentrations (200 mg l^{-1}). Their surface was composed of organic acids (LCFA) which bond Ca (LCFA - Ca) and in the inner part apatite ($Ca_5(PO_4)_3$, Al, Ca-phosphates, Mg-phosphates were found. Long term in situ experiments are carried out in high pressure vessels in order to characterize the microbial impact on the reservoir components of a depleted natural gas field and to assess the interaction with CO_2 storage. In order to study mobilization effects of supercritical CO_2 rock cores will be incubated with different concentrations of organic material and elevated concentrations of Ca^{2+}, Mg^{2+}, Fe^{2+} to characterize changes in the microbial communities as well as the mineral composition. First results of these experiments will be presented at the EGU General Assembly 2011.