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Analysis of the microbial community from a saline aquifer during CO_2 storage in Ketzin using improved Fluorescence in situ Hybridisation method

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In order to investigate the possibility of underground CO_2 storage, a research facility in Ketzin (Germany, west of Berlin) is operated where CO_2 is stored in a subsurface saline aquifer. Three 700-850 m deep holes were constructed relatively, one injection well containing the injection tubing and two observation wells harbouring measuring technique. Since the Earth subsurface is known to be a major habitat for a high number of different groups of microorganisms, our working group aims at characterising microbial reactions between the gas (either dissolved in water or in the supercritical state), fluid and the mineral content of both the reservoir rock and the cap rock. Main purpose of the microbial monitoring is to analyse compositions and activities of the microbial communities in order to characterize microbial life in extreme habitats and its influence on corrosion and mineral dissolution and precipitation. Analyses of microbial community composition and its changes provide information about the effectiveness and reliability of long-term CO_2 storage technique.
Our previous study revealed that up to 106 cells ml-1 were detected in the first observation well, where CO_2 break through after injection of 500 t (Morozova et al., 2010). For the identification and enumeration of the microorganisms, a widely applied fluorescence in situ hybridisation (FISH) method was applied. FISH coupled with rRNA-targeted oligonucleotide probes allows direct visualisation, identification and localisation of bacterial cells from selected phylogenetic groups. However, its application to the samples from the second observation well, where CO_2 arrived after injection of approximately 11.000 t, was hampered. The presence of solids and particles in the reservoir fluids significantly interfered with the cell visualization using epifluorescent microscopy. Since it is difficult to distinguish cells among particles and this strongly hinders the identification and enumeration of bacteria, an optimization of the FISH method was done with the new developed method – a combination of chemical and physical treatment followed by density centrifugation through a cushion of Nycodenz in order to separate bacteria from sediment matrix, and to avoid false fluorescent signals given by some organics and minerals. This method was successfully used on reservoir fluid samples from the second observation well prior to FISH. The detailed study on the activity, quantity and physiology of the microbial communities was performed by using various probes which are targeting different groups of microbes. The results of microbial monitoring gained from the first observation well (Morozova et al., 2011) was compared with the results from the second observation well in order to draw broader conclusions about the microbial community response to CO_2 injection, chemical fluid composition and the well completion procedure.
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