Stepwise C & O stable isotope shows no detectable CO_2-sequestration by cements in analogue for engineered storage

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Geochemical models often predict a relatively rapid growth of carbonate minerals as the most secure form of long term, engineered, CO_2 storage. But validation of model-results remains difficult due to the long periods of time involved, 1000's of years. Natural analogue studies can bridge the gap between experiments and real-world storage.

The Fizzy field, a southern North Sea (UK) gas accumulation with a high natural CO_2 content (c. 50%) provides an ideal opportunity to study the long term effect of CO_2 related mineral reaction. However all such reservoirs contain 'normal' diagenetic dolomite, so that distinguishing sequestration related dolomite is a challenge. Previous petrographic work and comparison of stable carbon and oxygen isotopes from dolomite in the Fizzy field and dolomite in the Orwell field, an adjacent gas field with low CO_2 content, did not find major differences [1]. However, stable isotope measurements were only made on whole-rock samples such that internal zonations of crystals may have been masked.

We extracted CO_2 from dolomite from both the Fizzy and the Orwell gas field in a stepwise manner in order to reveal any zonation of the crystals which could be related to enhanced dolomite precipitation due to the high CO_2 concentration. The results do not match with the calculated isotopic equilibrium composition for the CO_2 which is currently present in the Fizzy field but are comparable with data from the adjacent low CO_2 Orwell field. We conclude that the dolomite present in the Fizzy field is not related to high CO_2 concentration but a product of earlier diagenetic events.

[1] Wilkinson *et al*. (2009) *Journal of Sedimentary Research* **79**, 486-494.

Investigation of organo-mineral interactions in artificial soil incubations by NanoSIMS

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Soils are complex mixtures of minerals, organic material (OM) and microorganisms. These components interact with each other, forming biogeochemical interfaces (BGIs). BGIs in soils are believed to be hot-spots where many important processes like sorption and microbial activity occur. Thus, depending on the components involved, various microhabitats for soil microorganisms are created.

In order to study the effect of mineral composition on the development of BGIs, we performed an artificial soil incubation experiment. The artificial soils are model systems, comprising of well-defined mixtures of various minerals like quartz, clay minerals and iron and aluminium hydroxide and sterilized manure as organic substrate that were inoculated with soil microorganisms and incubated over different time periods up to 18 months.

The microorganisms were active and OM turnover occurred in the soil systems. Phospholipid-derived fatty acid (PLFA) pattern showed that the initial composition of the artificial soils initiated the development of different soil microbial communities.

Selected samples after one year of incubation were investigated with nano-scale secondary ion mass spectrometry (NanoSIMS) to study BGI formation. NanoSIMS analysis demonstrated that patchy attachment of OM occurred to clay minerals. Up to now, no intact microbial cells were detected in the artificial soils using NanoSIMS, which is probably due to sample pretreatment or too low abundance of microorganisms in these samples.

Our data demonstrate that in these simple soil systems, depending on the mineralogical composition, microhabitats were created, and that NanoSIMS is a tool to visualize these hot-spots in soil at a relevant scale.