Geophysical Research Abstracts
Vol. 16, EGU2014-11901, 2014
EGU General Assembly 2014

The N cycle in Earth subsurface. Reactivity of functional genes to anthropogenic CO_2 injections.

Rosalia Trias (1,2), Emmanuelle Gérard (1,2), Paul Le Campion (1,2), Sigurður R. Gíslason (3), Edda S. Aradóttir (4), Helgui A. Alfreðsson (3), Kiflom G. Mesfin (3), Sandra Ó. Snæbjörnsdóttir (3), Bénédicte Ménez (1,2)

(1) Géobiosphère actuelle et primitive, Institut de Physique du Globe de Paris, Sorbonne Paris Cité, Université Paris Diderot, CNRS UMR 7154, 1, rue Jussieu, 75238 Paris, France, (2) Centre de Recherche sur le Stockage Géologique du CO_2, IPGP / TOTAL / SCHLUMBERGER / ADEME, (3) Institute of Earth Sciences, University of Iceland, Reykjavik, Iceland, (4) Reykjavik Energy, Reykjavik, Iceland

The Nitrogen cycle has been widely studied in surface ecosystems, due to the importance of this nutrient for the organisms' development, and to the impact in the environment of most of the N forms, many of them being considered pollutants. However, little is known about the importance of the N-related metabolisms in subsurface systems now recognized to host diverse and active microbial life. In this study, we have periodically sampled the subsurface aquifers of the Icelandic pilot site for CO_2 storage associated with the geothermal plant of Hellisheidi (operated by Reykjavik Energy; http://www.or.is/en/projects/carbfix). With the aim of understanding the dynamics of N-cycle in the subsurface, and its reactivity to CO_2 injections, we quantified through qPCR the functional genes *amoA* (archaea), *amoA* (bacteria), *nirK, nirS, nosZ, nifH*, and the 16SrRNA genes of the anammox, total archaea and total bacteria.

The 16SrRNA gene quantification provided values of around 10^7 gene copies/l at non injection periods. CO_2 injection caused first a slight decrease probably due to pH decrease or toxicity by oxygen contamination during the injections. Two months after injection, the copy numbers increased up to 10^9 gene copies/l, and slowly returned to pre-injection values. The archaeal 16S rDNA copy numbers showed a similar reaction, with higher toxicity effects, and a lower increase afterwards.

Due to the high reactivity of the microbial populations to CO_2 injections, all the N cycle quantifications were related to the total 16S rDNA copies for normalization. Nitrifying genes (*amoA*) were mainly represented by the ammonia oxidizing archaea, and were apparently not affected by CO_2 injections. Anammox bacteria were present in a very low percentage, and the obtained copy numbers tended to decrease after the injection. These results were surprising due to the autotrophic character of ammonia oxidizers, but could be explained by a competitive exclusion. On the contrary, N-fixation (*nifH*) was stimulated by the injections, doubling their relative abundance in relation to bacteria 16S rDNA copy numbers, supplying the N requirements of new biomass formed by autotrophic CO_2 fixation. Finally, denitrifying bacteria (*nirK, nirS* and *nosZ*) showed a higher seasonal variation, but were positively stimulated by the CO_2 injections. This process can be autotrophic in some species, using directly the injected CO_2 as C source.

Altogether the results suggest a high response of the N cycle to the CO_2 injections, and its potential contribution to the formation of new biomass and C fixation. We provide evidences for the importance of the N cycle on the subsurface and its reactivity to CO_2 injections, being therefore important the consideration of this cycle in CO_2 storage modelling.