Unexpected high reactivity of deep biota under anthropogenic CO_2 injection into basalt

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Basalts are recognized as one of the major habitats on Earth, harboring diverse and active microbial populations. Inconsistently, this living component is rarely considered in any engineered operation carried out in these environments. This includes carbon capture and storage (CCS) technologies that seek to offset anthropogenic CO_2 emissions into the atmosphere by burying this greenhouse gas in the subsurface. In this study, thanks to the Carbfix consortium (https://www.or.is/english/carbfix-project), we have carried out the first microbiological survey of a basaltic CCS site associated with the geothermal powerplant of Hellishei (SW Iceland) [1]. We show that deep ecosystems are quickly responsive to field operations associated with CO_2 injections. Acidifying CO_2-charged groundwaters result in a marked decrease in microbial richness while lithoautotrophic iron-oxidizing betaproteobacteria together with degraders of aromatic compounds bloom, hence impacting the redox state of the aquifer and the carbon fate. We show in particular that host-basalt dissolution was key in releasing nutrients and energy sources sustaining autotrophic and heterotrophic growths with possible consequences of the stimulated microbial activities on mineral storage.

[1] Matter, J.M. et al. Rapid carbon mineralization for permanent disposal of anthropogenic carbon dioxide emissions. Science 352, 1312-1314 (2016).