

Depth profile of $^{129}\text{I}/^{127}\text{I}$ ratio in Andisol collected in preserved field of NIAES, Tsukuba, Japan

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Depth profile of $^{129}\text{I}/^{127}\text{I}$ ratio were measured as well as iodine concentration, carbon concentration and $^{14}\text{C}/^{12}\text{C}$ in Japanese Andisol collected in the well preserved field of National Institute for Agro-Environmental Sciences, Tsukuba, Japan. Today, most of ^{129}I in the surface environment involving soils is originated in the human nuclear activities: atmospheric nuclear bomb testing, spent nuclear fuel reprocessing, and nuclear accident. To estimate total deposition of ^{129}I in soil precisely and to investigate iodine transfer process correctly, the depth profile information is essential. From the gradient of the profile iodine transfer model can be constructed. If $^{14}\text{C}/^{12}\text{C}$ profile shows the signal from the bomb testing (110 pMC just below the surface), the sampling field has been undisturbed at least several decades [1]. This study was the case.

Resulting $^{129}\text{I}/^{127}\text{I}$ depth profile shows steep decreasing trend above 20cm depth. This part can be fitted simple diffusion curve (error function). Below this depth $^{129}\text{I}/^{127}\text{I}$ come to be rather constant. This observation suggests that there are at least two component of iodine: quick diffusion component (with which most of recent ^{129}I is carried) and rather static component (maybe as old as the mother material of the soil).

The maximum $^{129}\text{I}/^{127}\text{I}$ ratio in Tsukuba (this study) is 1.67×10^{-8} at 1.5cm deep which is as twice as higher than the Shimokita soil (7.29×10^{-9}) [1]. This should be due to the influence of a nuclear fuel reprocessing plant at Tokai area located about 60km northern east of Tsukuba. Total deposition density of ^{129}I was calculated using $^{129}\text{I}/^{127}\text{I}$ ratio profile and iodine concentration of each depth and soil density. That was 0.036 Bq/m^2 corresponding to $2.6 \times 10^{13} \text{ atoms/m}^2$. These data should be a reference for the evaluation of the influence of the nuclear power plant accident like the Fukushima dai-ichi power plant.

[1] H. Matsuzaki *et al.* (2010) *Radiocarbon* **52**(2–3), 1487–1497.

Tracking permanent CO₂ storage in basaltic rocks using conservative and reactive tracers at the CarbFix injection site, Iceland

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Injection of CO₂ modifies ambient formation waters, inducing fluid-rock reactions that may lead to mineral carbonation of the CO₂. In the CarbFix pilot CO₂ injection project in Iceland, we are investigating *in situ* mineral carbonation of CO₂ in a basaltic aquifer. At the moment, the pilot test involves the injection of 2, 200 tons of CO₂. The CO₂ is injected dissolved in water at a rate of 0.07 kg/s of CO₂ in 2 kg/s of water at 19°C [1].

The success of mineral carbonation in basaltic rocks depends on the ability to monitor and understand the behavior of the injected CO₂. The currently existing monitoring techniques in CO₂ capture and storage are insufficient to characterize mineral carbonation in any storage reservoir. Most geophysical detection methods require that CO₂ is present as a supercritical phase. Dissolved CO₂ and chemically transformed carbon thus avoid detection.

We are using a multi tracer approach, including conservative and reactive tracers to track CO₂ storage in basaltic rocks. Trifluoromethylsulphur pentafluoride (SF₅CF₃), a conservative tracer, is injected in pulses into the CO₂ gas stream at a concentration of 2700 pptv. It is used to characterize the physical transport processes of advection and dispersion of the CO₂ solution. Furthermore, the injected CO₂ is tagged with radiocarbon (¹⁴C). Radiocarbon is injected as dissolved bicarbonate at a concentration of $1.20 \times 10^4 \text{ Bq/kg}$ of injected water. This results in 5x enrichment compared to the 1850 background. The total ¹⁴C activity needed for the 2, 200-ton injection is $7.44 \times 10^8 \text{ Bq}$ or 20 mCi. We use ¹⁴C as a tracer to monitor the CO₂ reactivity in the storage reservoir. Its ratio to carbon in the groundwater of the basaltic aquifer will change as a result of dissolution and precipitation of carbonate minerals. Thus, by measuring the carbon isotopic ratio in water samples collected in monitoring wells, we are able to quantify and verify *in situ* mineral carbonation and therefore long term storage.

[1] Gislason *et al.* (2010) *Int. J. Greenh. Gas Con.* **4**.