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Isotopic signature of production and uptake of H2 by soil

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Molecular hydrogen (H2) is the second most abundant reduced gas in the atmosphere, with background concentration and δD value of approximately 550 ppb and -130‰ respectively. Our studies focus on the microbial production and uptake of H2 by soil. The biogenic soil sink of molecular H2 is the largest and most uncertain term in the global atmospheric H2 budget. With this large uncertainty, it is difficult to predict how atmospheric H2 may respond to future changes in climate or anthropogenic emissions. The biological N2 fixation on land is a poorly understood source of H2, which contributes approximately 4% of the total source strength. Although it is globally a minor H2 source, it has potentially a large local effect on the isotopic composition of H2, due to its very deuterium-depleted source signature. To better understand the soil sink and source, one possibility is to investigate the isotopic fractionation processes involved. Due to the large mass difference between HH and HD, the isotope effects are particularly large for H2, but studies on this subject are sparse.

To constrain the biogenic source and sink, we carried out both continuous and flask measurements for air samples collected from a grass field and an old forest in the Netherlands. We studied the isotopic fractionation during H2 soil uptake, and the isotope signature of biogenic H2 produced from N2 fixation. This knowledge will be useful to constrain the production and uptake rate of H2 by soils.