



## Using natural isotopic abundances to determine the source of nitrous oxide (N<sub>2</sub>O) emissions

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Numerous greenhouse gas studies have focused on carbon dioxide (CO<sub>2</sub>), whereas nitrous oxide (N<sub>2</sub>O) also plays a major role in global warming. Indeed, while nitrous oxide is 1000 times less concentrated than CO<sub>2</sub> in the atmosphere, it is 300 times more efficient in terms of global warming potential. In addition, its atmospheric concentration increases with 0,3 % per year.

According to the literature, nitrous oxide is produced, in soils and sediments, by two major processes:

- (1) Nitrification, mediated by autotrophic nitrifying bacteria under oxic conditions;
- (2) Denitrification, mediated by heterotrophic denitrifying bacteria under anoxic conditions.

Denitrification induces intensive, localized and instantaneous fluxes. N<sub>2</sub>O emissions can be easily measured and modeled. In contrast, nitrification induces weak emissions, but spatially and temporally extended. Therefore, this process could represent a large potential of N<sub>2</sub>O emissions from soils and sediments.

The study of isotopomer's isotopic composition of N<sub>2</sub>O, i.e. the intramolecular distribution or site preference (SP) determined by <sup>15</sup>N measurement allows the determination of the origin of N<sub>2</sub>O emissions (nitrification vs. denitrification). Recent studies on pure cultures have showed that SP associated with nitrification is 35 ‰ while SP associated with denitrification is 0 ‰.

The aim of this study was to determine SP associated with denitrification in soils and sediments, taking into account the environmental denitrifying bacterial communities, and under different environmental variables. To this end, flow-through reactors were used to determine denitrification rates at different temperatures and varying substrate (nitrate) concentrations. Site preference was measured for the different experiments.

Different experiments of denitrification were realized in sediment flow through reactors under denitrifying conditions (anoxia, presence of organic matter and nitrate).

We used acetylene (25°C) to block the enzyme nitrous oxide reductase, resulting in accumulation of N<sub>2</sub>O originating only from denitrification. Despite the fact that the isotopic composition of the produced N<sub>2</sub>O (<sup>15</sup>N and <sup>18</sup>O) varies, the SP did not change significantly (SP = 6 ‰). These results compared to those of chemical denitrification show that despite very different isotopic compositions, the SP value is independent of the type of denitrification.

Different nitrate concentrations (5 mM, 3 mM, 1,5 mM and 1 mM) at ambient temperature (25°C). The results of N<sub>2</sub>O production kinetics were not related to nitrate concentrations. SP of N<sub>2</sub>O are currently being analyzed.

Different temperatures (35°C, 25°C and 12°C) and a nitrate concentration of 5 mM. The results of N<sub>2</sub>O production kinetics at different temperatures show an increase in N<sub>2</sub>O emissions with increasing temperature. SP of N<sub>2</sub>O are currently being analyzed.

The goal for future work is to study the SP in these systems relative to salinity, pH and carbon organic concentration in denitrifying conditions but also in nitrifying conditions.