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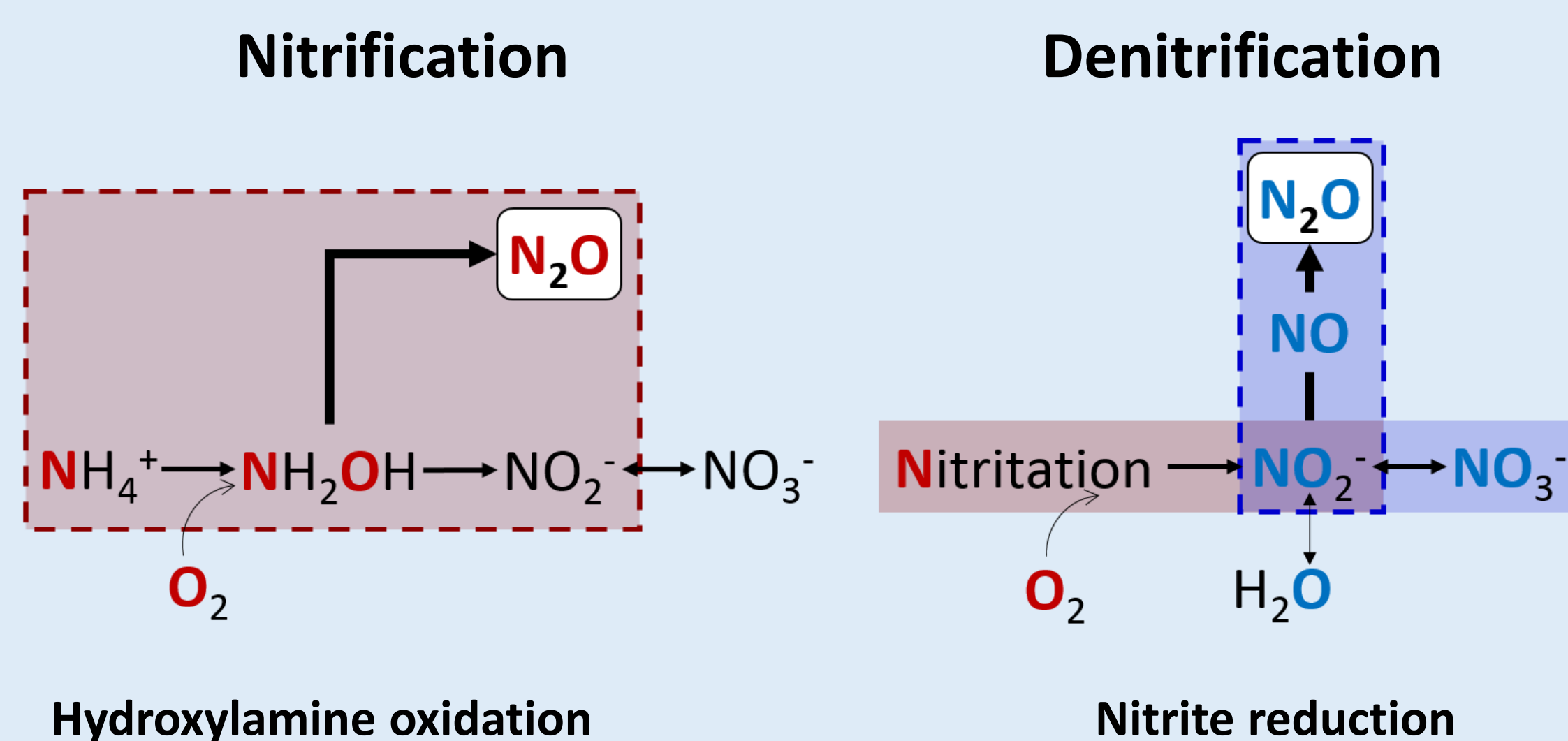


# N<sub>2</sub>O Track Isotopic evidence for alteration of nitrous oxide emissions and producing pathways contribution under nitrifying conditions

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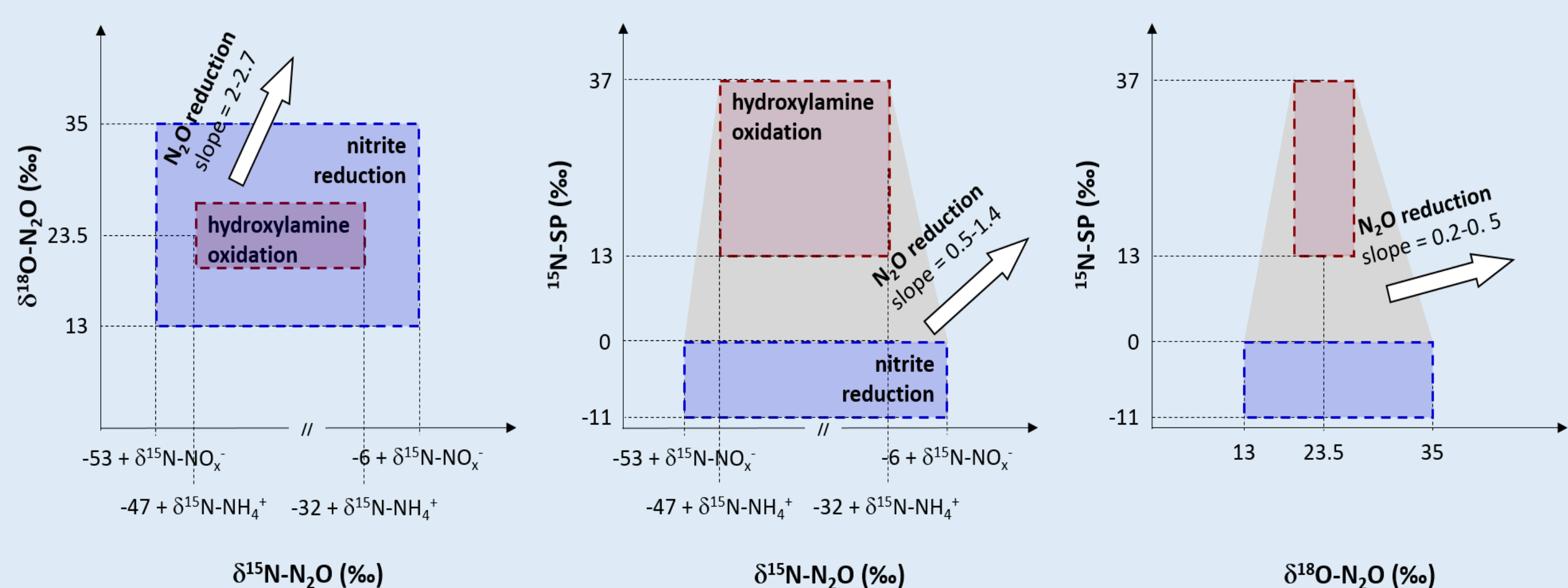
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## N<sub>2</sub>O producing pathways



### Hypothesis on N<sub>2</sub>O production Koba et al. 2009, GCA :

- ✓ Substrate isotope composition Snider et al. 2013, GCA
- ✓ Referenced isotope effects Denk et al. 2017, SBB
- ✓ Referenced <sup>15</sup>N-SP Lewicka-Szczepak et al., 2014, GCA; Sutka et al., 2006, AEM; Yamazaki et al., 2014, BG



## Research questions

- Can we deduce N<sub>2</sub>O producing pathways using isotope measurements under nitrifying conditions?
- Do oxygenation, temperature, and ammonium (NH<sub>4</sub><sup>+</sup>) concentration alter N<sub>2</sub>O emissions, and what are the involved processes?

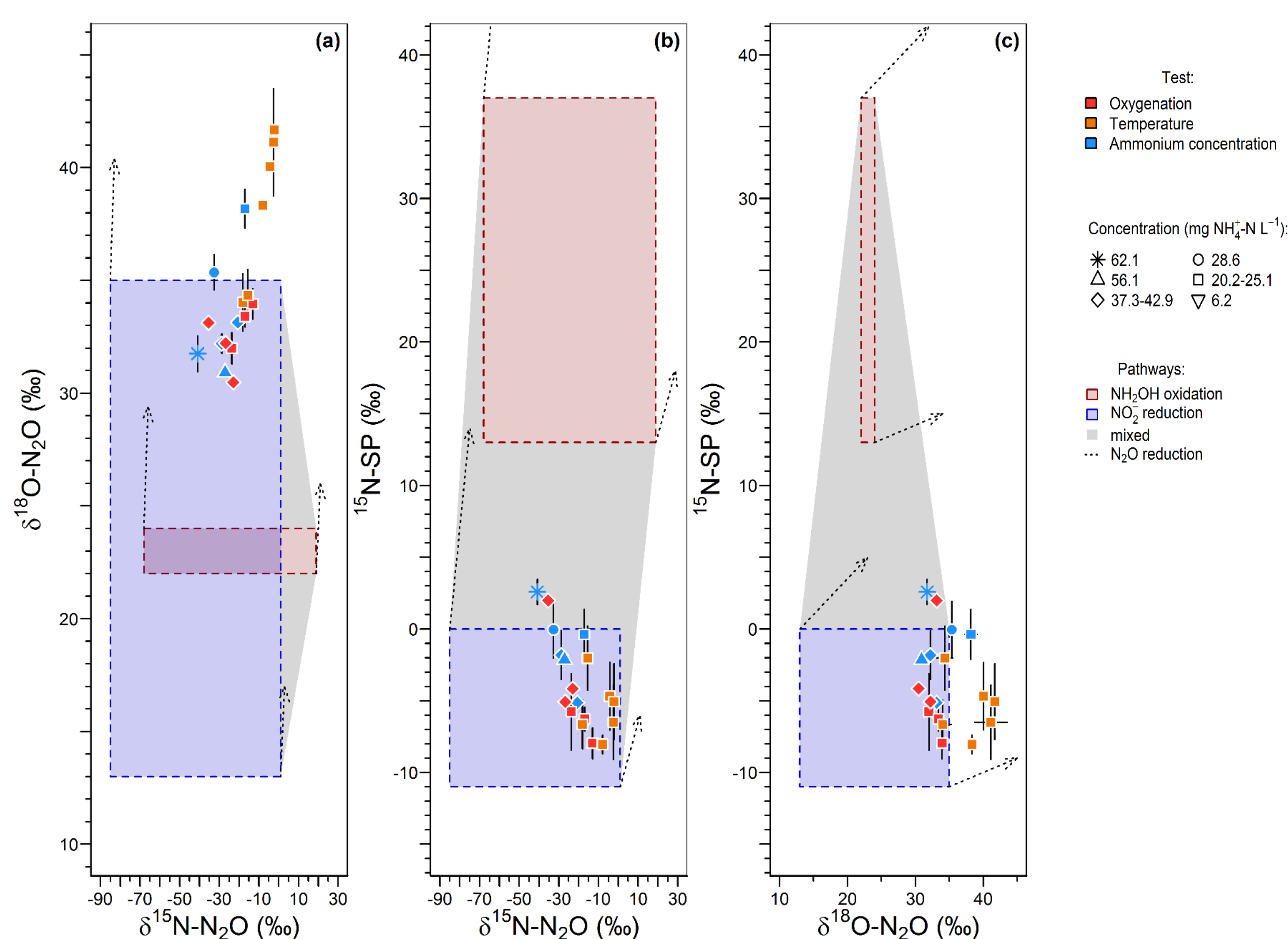
## Material & Methods

- Lab-scale nitrifying biologically active filter**
  - ✓ Oxygenation: 0- 21 % O<sub>2</sub> in gas mix
  - ✓ Temperature: 13- 22 °C
  - ✓ NH<sub>4</sub><sup>+</sup> 6- 62 mg N L<sup>-1</sup>
- Monitoring :**
  - ✓ Nitrification yield: NH<sub>4</sub><sup>+</sup>, NO<sub>2</sub><sup>-</sup>, NO<sub>3</sub><sup>-</sup>, N<sub>2</sub>O
  - ✓ Operating conditions: O<sub>2</sub>, pH
- Isotope analysis:**
  - ✓ N and O isotope ratios ( $\delta^{15}\text{N}$  and  $\delta^{18}\text{O}$ )
  - ✓ N isotopomer site preference (<sup>15</sup>N-SP)

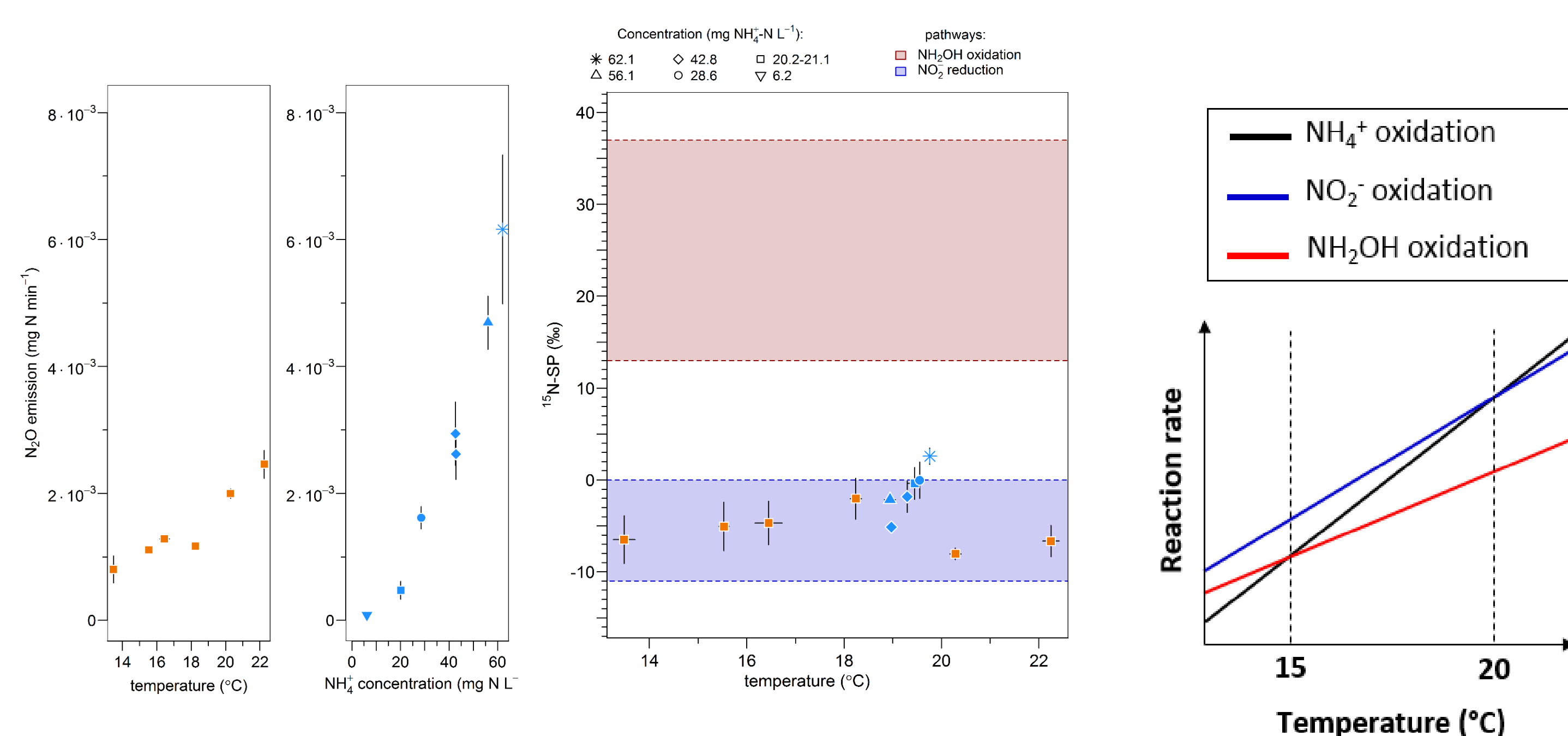


## Results

- N<sub>2</sub>O isotope composition data revealed that:
  - ✓ **Nitrite reduction** was the main N<sub>2</sub>O producing pathway
  - ✓ **Heterotrophic denitrification** occurred



- Difference in **temperature dependency** of hydroxylamine and ammonium oxidizers as driver of **hydroxylamine oxidation** contribution to N<sub>2</sub>O emissions



- 15 < T < 20 °C: linear increase in the contribution of the hydroxylamine oxidation pathway to N<sub>2</sub>O emission
- T > 20 °C: increase in the contribution of the nitrite reduction pathway to N<sub>2</sub>O emission. Ammonium oxidation rates exceed nitrite oxidation rates?

## Conclusions

- Difference in oxidation and reduction rates of nitrite as key driver of nitrite reduction contribution to N<sub>2</sub>O emissions
- The combination of low N<sub>2</sub>O emissions and high nitrification rates would occur close to 15 °C