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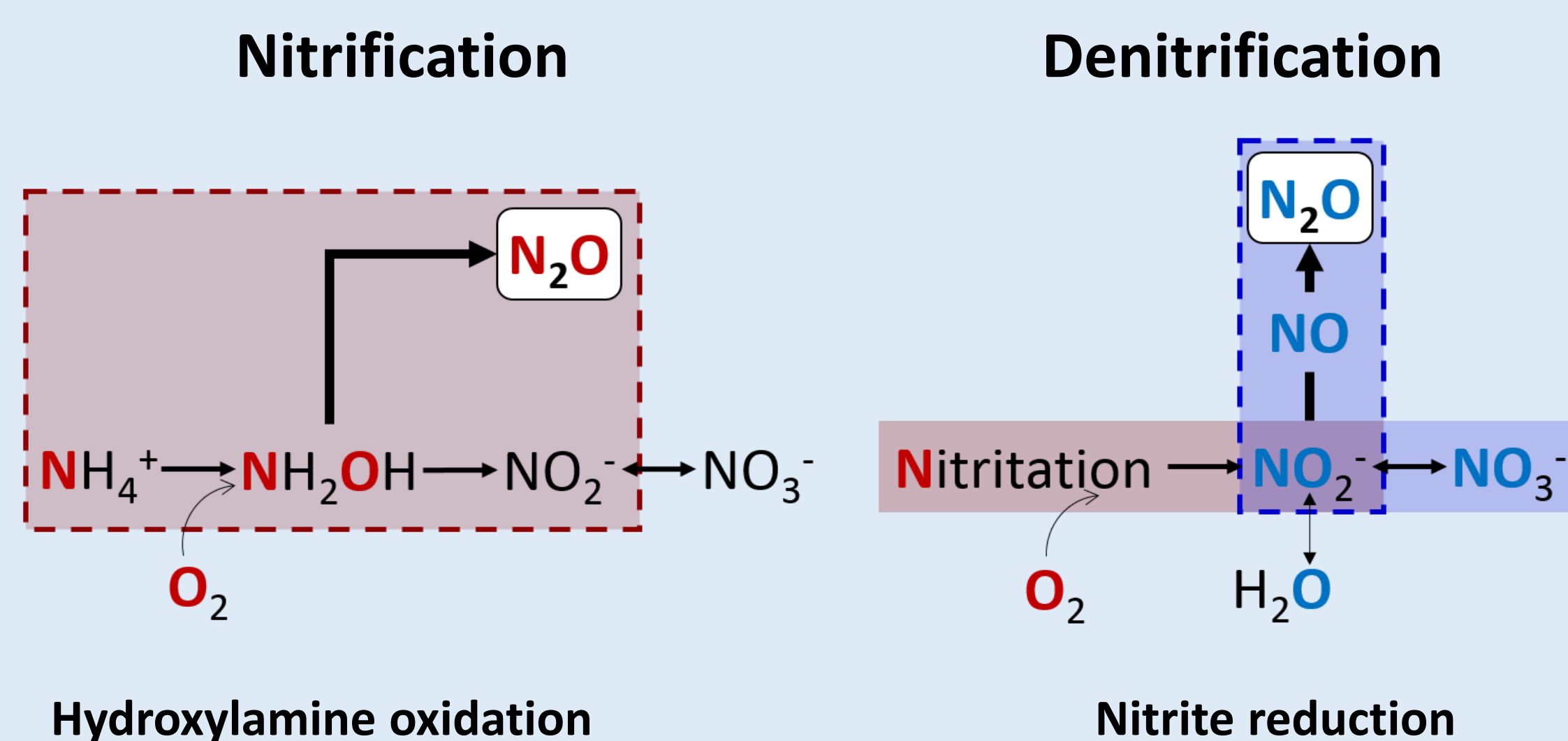
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N₂O Track Isotopic evidence for alteration of nitrous oxide emissions and producing pathways contribution under nitrifying conditions

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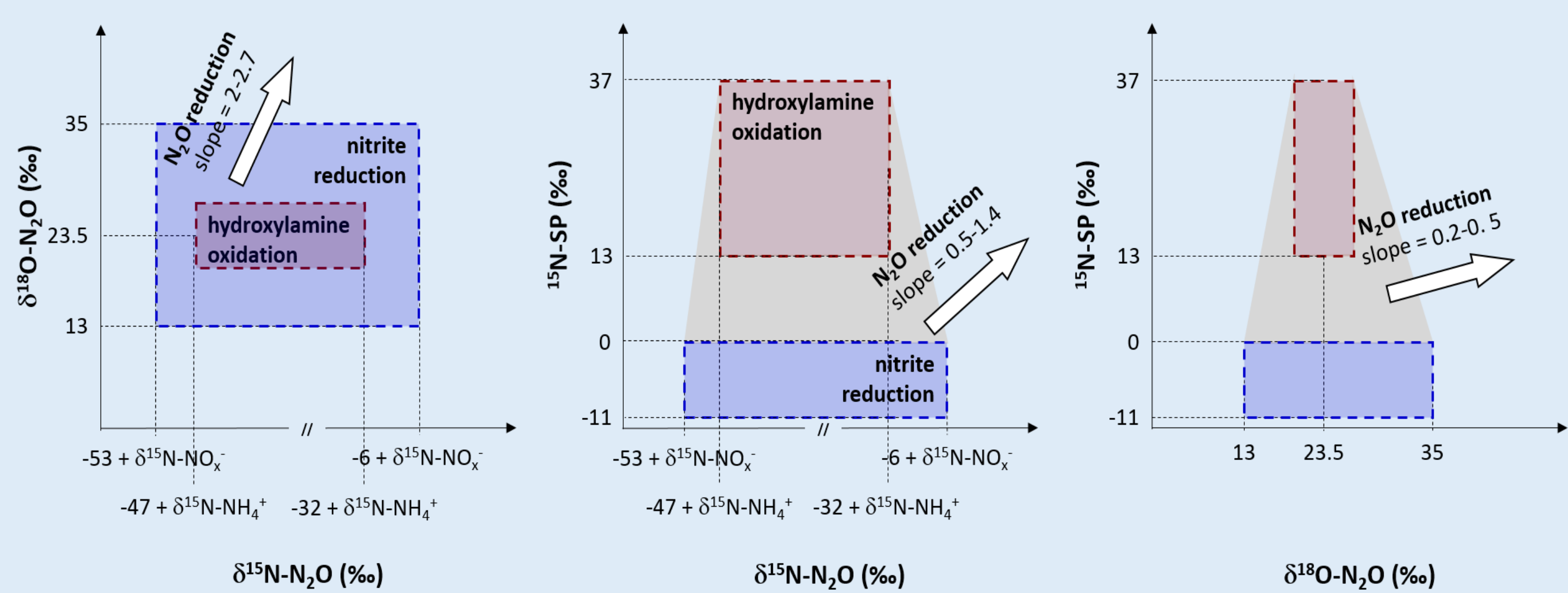
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N₂O producing pathways



Hypothesis on N₂O production Koba et al. 2009, GCA :

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



Research questions

- Can we deduce N₂O producing pathways using isotope measurements under nitrifying conditions?
- Do oxygenation, temperature, and ammonium (NH₄⁺) concentration alter N₂O emissions, and what are the involved processes?

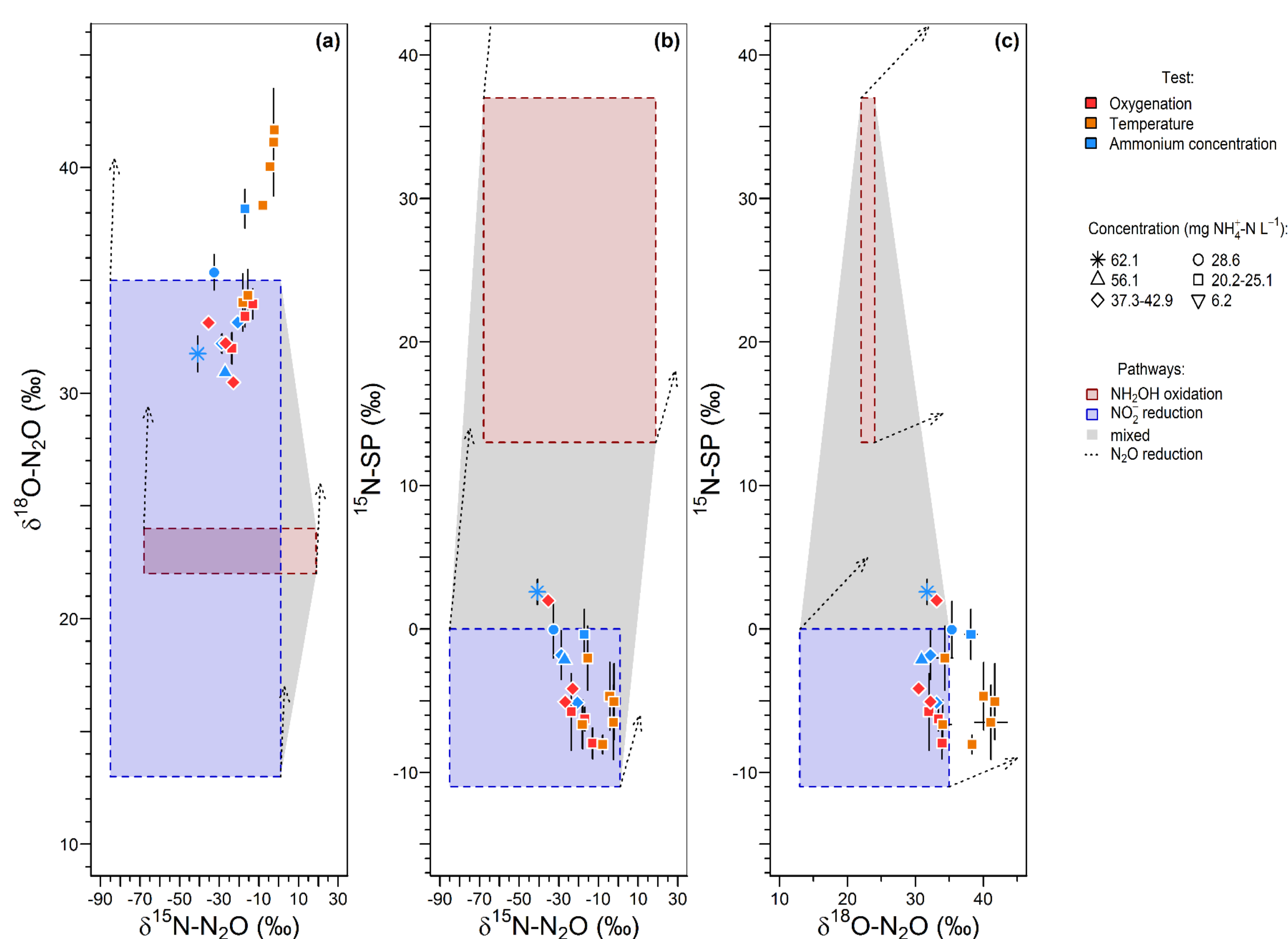
Material & Methods

- Lab-scale nitrifying biologically active filter**
 - ✓ Oxygenation: 0- 21 % O₂ in gas mix
 - ✓ Temperature: 13- 22 °C
 - ✓ NH₄⁺ 6- 62 mg N L⁻¹
- Monitoring :**
 - ✓ Nitrification yield: NH₄⁺, NO₂⁻, NO₃⁻, N₂O
 - ✓ Operating conditions: O₂, pH
- Isotope analysis:**
 - ✓ N and O isotope ratios (δ¹⁵N and δ¹⁸O)
 - ✓ N isotopomer site preference (¹⁵N-SP)

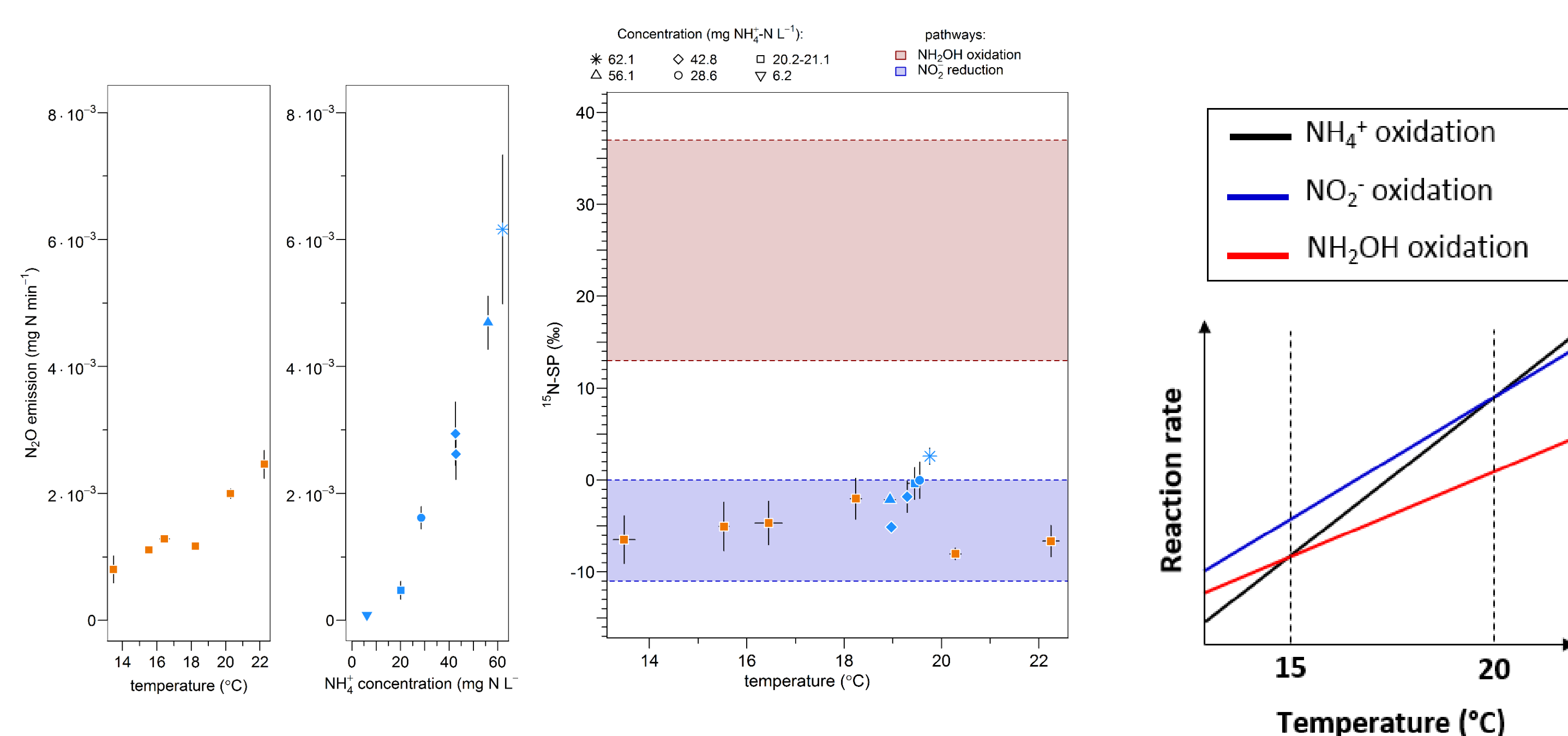


Results

- N₂O isotope composition data revealed that:
 - ✓ **Nitrite reduction** was the main N₂O producing pathway
 - ✓ **Heterotrophic denitrification** occurred



- Difference in **temperature dependency** of hydroxylamine and ammonium oxidizers as driver of **hydroxylamine oxidation** contribution to N₂O emissions



- 15 < T < 20 °C: linear increase in the contribution of the hydroxylamine oxidation pathway to N₂O emission
- T > 20 °C: increase in the contribution of the nitrite reduction pathway to N₂O 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 N₂O emissions
- The combination of low N₂O emissions and high nitrification rates would occur close to 15 °C