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

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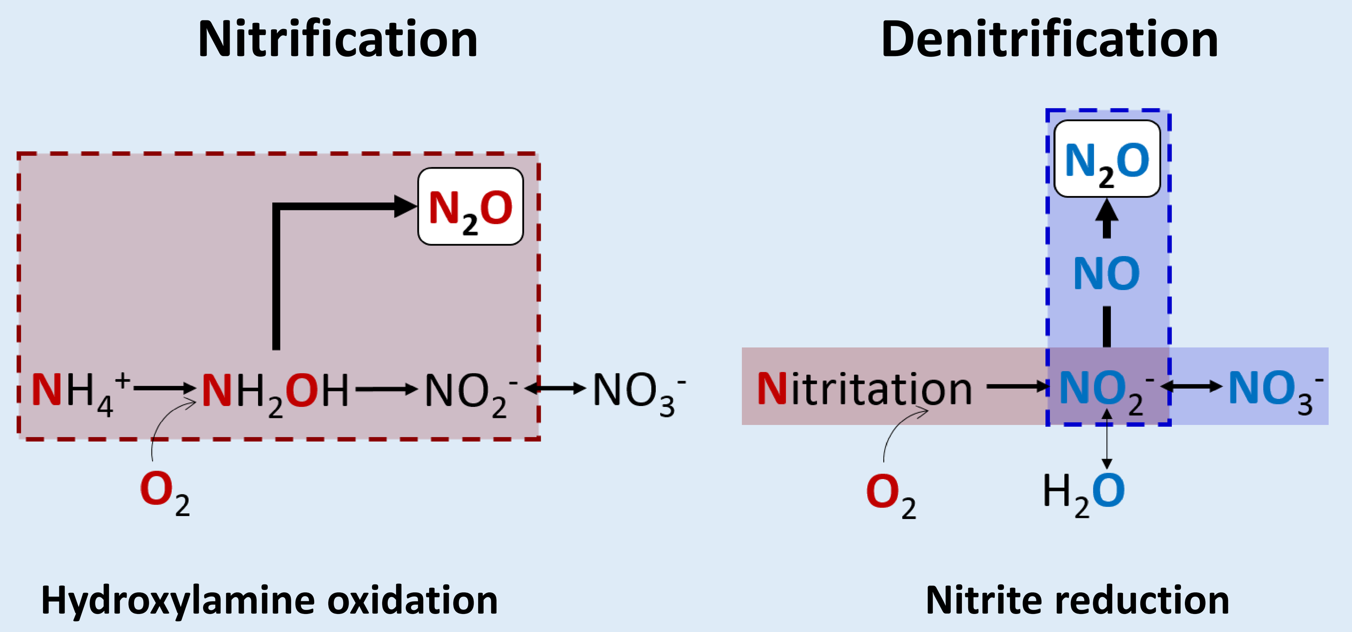
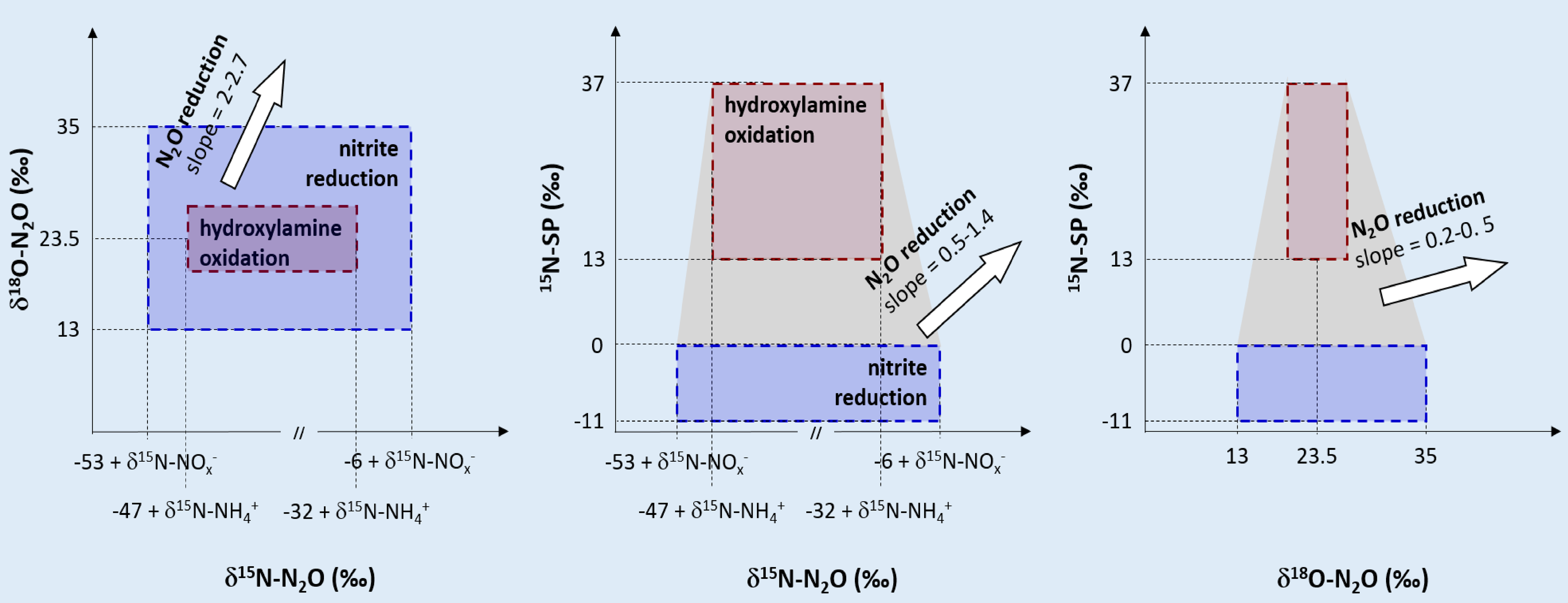
N_2O producing pathways



Hypothesis on N_2O production *Koba et al. 2009, GCA* **:**

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



Research questions

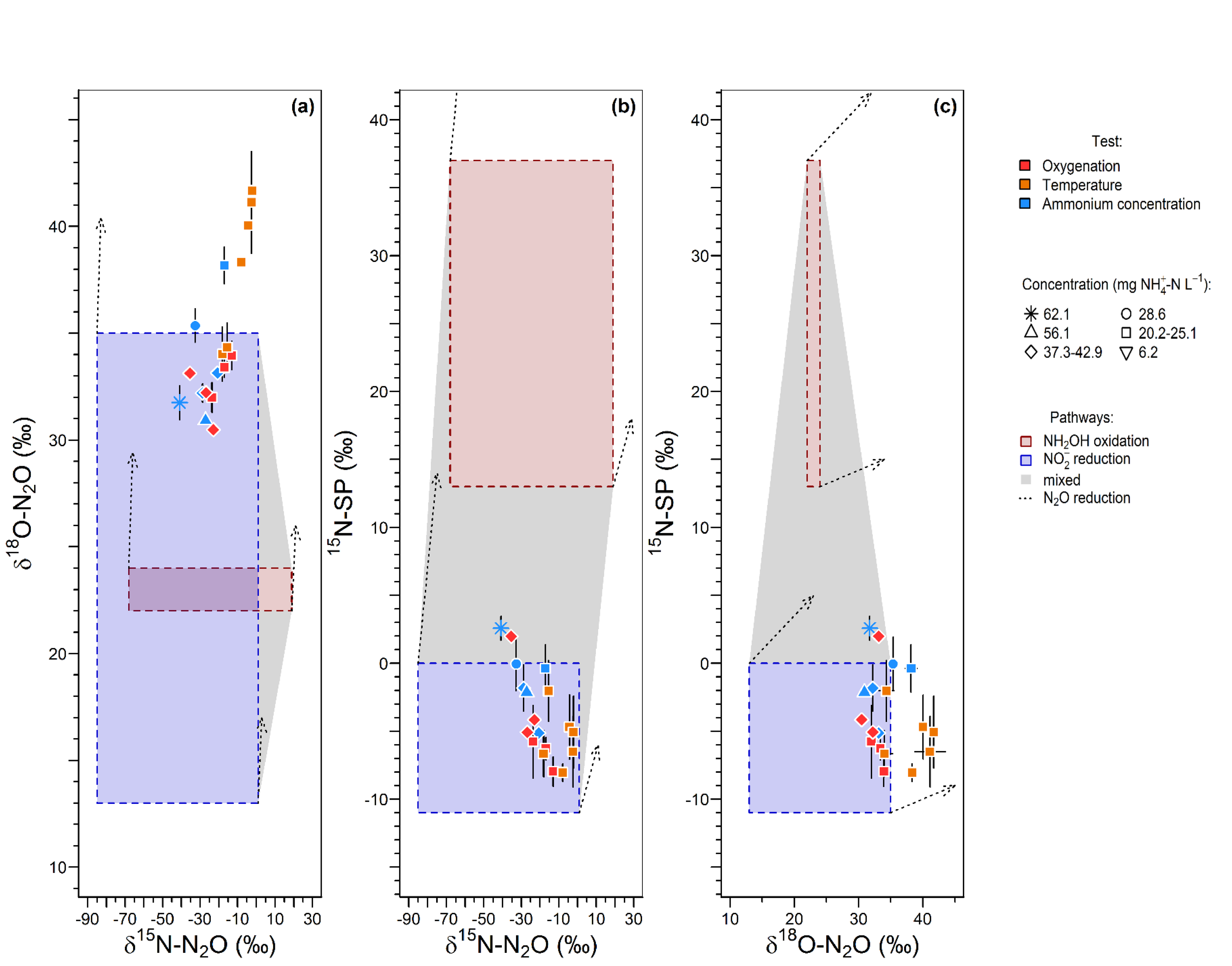
- Can we deduce N_2O producing pathways using isotope measurements under nitrifying conditions?
- Do oxygenation, temperature, and ammonium (NH_4^+) concentration alter N_2O emissions, and what are the involved processes?

Material & Methods

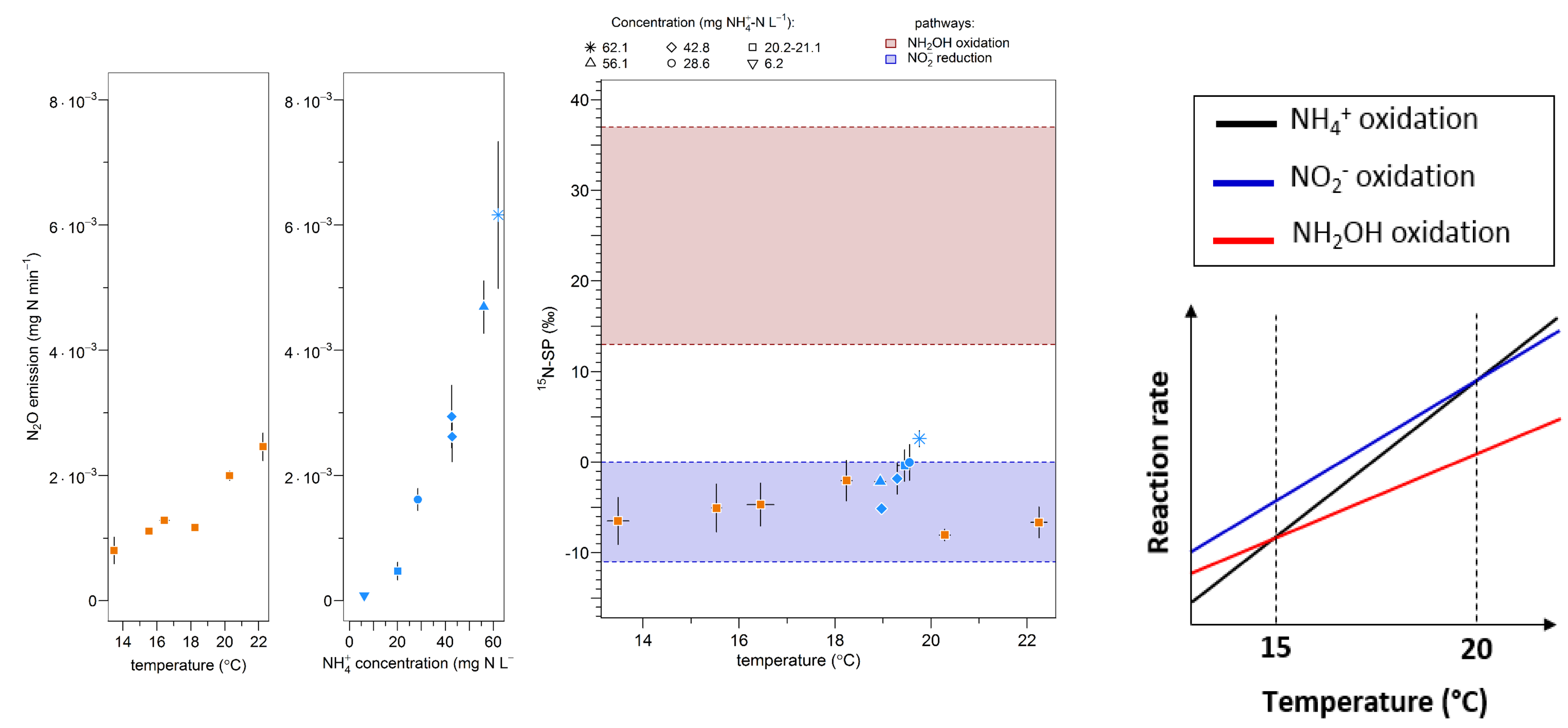
- **Lab-scale nitrifying biologically active filter**
  - ✓ Oxygenation: 0- 21 % O_2 in gas mix
  - ✓ Temperature: 13- 22 °C
  - ✓ NH_4^+ 6- 62 mg N L^{-1}
- **Monitoring :**
  - ✓ Nitrification yield: NH_4^+, NO_2^-, NO_3^-, N_2O
  - ✓ Operating conditions: O_2, pH
- **Isotope analysis:**
  - ✓ N and O isotope ratios (δ^{15}N and δ^{18}O)
  - ✓ N isotopomer site preference (^{15}N-SP)

Results

- N_2O isotope composition data revealed that:
  - ✓ **Nitrite reduction** was the main N_2O producing pathway
  - ✓ **Heterotrophic denitrification** occured



- Difference in **temperature dependency** of hydroxylamine and ammonium oxidizers as driver of **hydroxylamine oxidation** contribution to N_2O emissions



- 15 < T < 20 °C: linear increase in the contribution of the hydroxylamine oxidation pathway to N_2O emission
- T > 20 °C: increase in the contribution of the nitrite reduction pathway to N_2O 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_2O emissions

➢ The combination of low N_2O emissions and high nitrification rates would occur close to 15 °C