*Supplement of*

# On the fingerprint of the Antarctica ozone hole in ice core nitrate isotopes: a case study based on a South Pole ice core

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## Introduction

We here present: (1) Effect of the ozone hole on the $\delta^{15}N(NO_3^-)$ record in Dome A (Text S1); (2) Modeled $\delta^{15}N(NO_3^-)$ changes with different $\delta^{15}N(F_{pri})$ (Figure S1); (3) Parameters and variables used in the TRANSITS model (Table S1).

**Text S1: Effect of the ozone hole on the $\delta^{15}N(NO_3^-)$ record in Dome A**

At Dome A, East Antarctica, the average snow accumulation rate is about 0.023 w.e. m $yr^{-1}$ (Shi et al., 2015). Using TRANSITS model we calculated the preserved $\delta^{15}N(NO_3^-)$ before and in ozone hole period. In maximum ozone hole year (in 2001) the preserved $\delta^{15}N(NO_3^-)$ is 215.3 ‰, while before ozone hole (in 1979) the $\delta^{15}N(NO_3^-)$ below photic zone is 194.8 ‰.

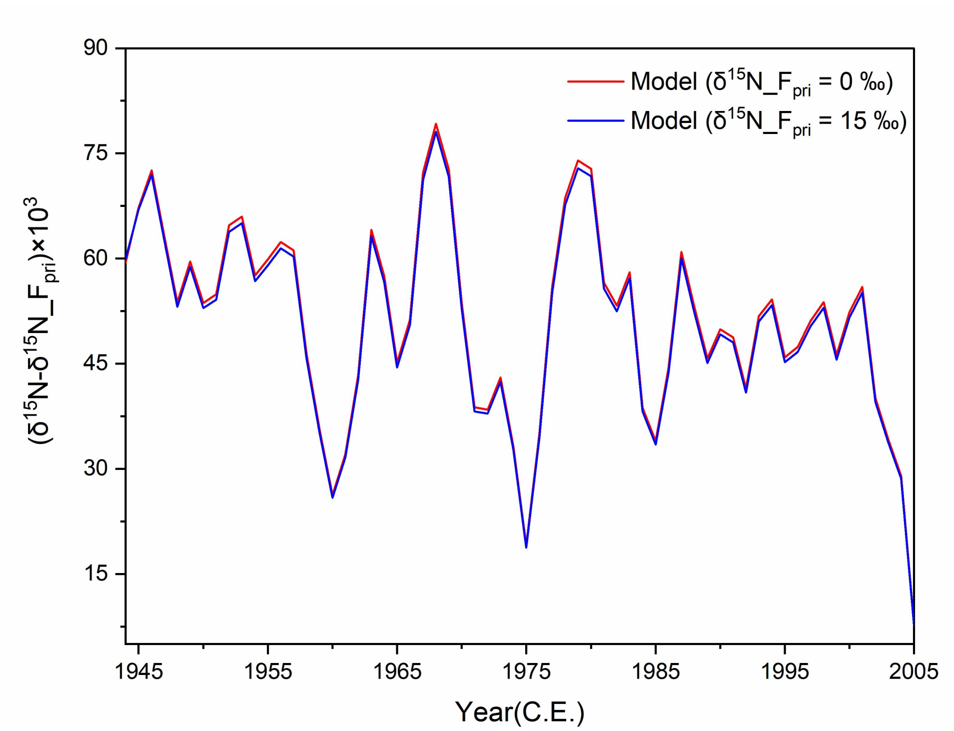


**Figure S1. Modeled $\delta^{15}N(NO_3^-)$ changes (i.e., the differences between preserved $\delta^{15}N(NO_3^-)$ and that of $F_{pri}$) with different $\delta^{15}N(F_{pri})$. Note other parameters were kept same in these two scenarios.**

| Parameter | Description | Value | Reference |
|---|---|---|---|
| h | Boundary layer height | 81 m | Neff et al. (2018) |
| T | Temperature | - | NOAA observation |
| P | Pressure | - | NOAA observation |
| TCO | Total column ozone | - | NOAA observation |
| A | Snow accumulation rate | - | Measured in this research |
| ρ | Snow density | 326 kg $m^{-3}$ | Measured in this research |
| σ | Nitrate cross section | - | Berhanu et al. (2014) |
| Φ | Quantum yield | 0.021 | Meusinger et al. (2014) |
| $O_3$ | Ozone concentration | - | NOAA observation |
| BrO | BrO concentration | - | Zatko et al. (2016) |
| $OH/HO_2/RO_2$ | $OH/ HO_2/RO_2$ concentration | - | Zatko et al. (2016) |
| $f_{cage}$ | Cage effect | 0.15 | Erbland et al. (2015) |
| $F_{pri}$ | Primary input nitrate | $2.4*10^{-6}$ kg N $m^{-2}$ $yr^{-1}$ | Zatko et al. (2013) |
| FS/FPI | Fluxes FT and FS ratio | 0.5 | Erbland et al. (2015) |
| $f_{exp}$ | Nitrate export fraction | 0.2 | Erbland et al. (2015) |
| $\gamma(NO_3^-)$ | Atmospheric nitrate concentration | $5.4*10^{-11}$ kg N $m^{-2}$ $yr^{-1}$ | Erbland et al. (2015) |
| $10^3\times\Delta^{17}O(FS)$ | $\Delta^{17}O$ in stratospheric input flux | 42 | Erbland et al. (2015) |
| $10^3\times\delta^{15}N(FS)$ | $\delta^{15}N$ in stratospheric input flux | 19 | Erbland et al. (2015) |

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|---|---|---|---|
| $10^3\times\Delta^{17}O$ (FT) | $\Delta^{17}O$ in tropospheric input flux | 30 | Erbland et al. (2015) |
| $10^3\times\delta^{15}N$(FT) | $\delta^{15}N$ in tropospheric input flux | 0 | Erbland et al. (2015) |

**Table S1. Parameters and variables used in the TRANSITS model.**

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