

**Nitrate production in the marine boundary layer
and its contribution to surface ocean along a cruise
path from China to Antarctica: An isotopic
perspective**

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Atmospheric deposition was thought to be an important contributor to nitrogen in global surface sea water. Thus, we collected atmospheric samples and surface seawater along a Chinese Antarctic research expedition cruise path (30°N to 70°S) to investigate sources and production of nitrate in the marine boundary layer and its contribution to surface ocean, using the nitrate isotopes ($\delta^{15}\text{N}$, $\delta^{18}\text{O}$ and $\Delta^{17}\text{O}$). Results show that elevated atmospheric nitrate in coastal areas is associated with human activity, while nitrate in the high southern latitudes tends to be influenced by Antarctic snowpack emissions. Linear relationship between $\delta^{18}\text{O}$ and $\Delta^{17}\text{O}$ suggests the dominant role of O_3 and $\text{H}_2\text{O}/\text{OH}$ in atmospheric nitrate production. In the tropics, most of atmospheric NO_3^- is produced via the OH channel, with more NO_3^- production via BrO and/or DMS pathways in the high southern latitudes. In surface seawater, high NO_3^- concentrations were present in the coastal areas and in the Southern Ocean. Zero $\Delta^{17}\text{O}$ of nitrate was observed in the estuary due to the extreme productive water, while positive $\Delta^{17}\text{O}$ (mean=1.7‰) in China coastal seawater nitrate was found, suggesting ~6.7% of seawater nitrate is from atmospheric deposition, and then $\Delta^{17}\text{O}$ of nitrate is back to zero everywhere else in the ocean. There is no obvious connection observed between the isotopes of surface seawater and atmospheric nitrate over the open ocean, suggesting that atmospheric deposition is difficult to change the isotopes of surface sea nitrate pool and the ocean is unlikely a source of atmospheric NO_x .

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