Isotopic compositions of nitrate in the surface snow layer from the coast to Dome Argus, East Antarctica

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In total, a set of 124 surface snow samples (the topmost 3±1 cm) collected along the traverse from coast to the ice sheet summit (Dome Argus) is used to investigate summertime atmospheric nitrate deposition across East Antarctica. The results show that concentration and isotopic compositions of NO_3^- in surface snow are more dependent on the distance from coast, compared to other physical variables (i.e., elevation and annual snow accumulation rate). The strong relationship observed between $\delta^{15}N$ and $\delta^{18}O$ of nitrate (R^2=0.69, p<0.001) suggests a large (lesser) extent of nitrate photolysis in the interior (coast) region. The significant linear correlation between the oxygen isotopes of nitrate ($\delta^{18}O$ vs. $\Delta^{17}O$) indicates mixing of various oxidants that react with NO_x (NO_x=NO+NO_2) to produce nitrate. In interior Antarctica, snow nitrate is closely related with the re-oxidation chemistry possibly occurring in both condensed and gas phases. Although the 'secondary' NO_3^- formation in the condensed phase is considered to be important in the interior snowpack [1], the oxygen isotope data cannot detect this (i.e., the re-formed nitrate in condensed phase vs. in gas phase). Snow-sourced NO_x from the interior due to photolysis of nitrate could be an important contribution to coastal nitrate formation and deposition, and transported nitrate from mid latitudes is possibly an additional source. This investigation suggests that the complete nitrate isotopic compositions in coastal ice core hold the potential for reconstructing NO_x and oxidant variability in coast and possibly mid latitudes.

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