Changes in the $\delta^{15}N$ of nitrate in Greenland ice: Implications for source changes over the last 500 years

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Recent increases in atmospheric nitrogen oxides may have a profound effect on terrestrial and lacustrine ecosystems through increases in the deposition of nitrogen. These nitrogen oxides, emitted from both anthropogenic (e.g., fossil fuel combustion) and natural (e.g., biomass burning, lightning, and soil emissions) sources, also affect the lifetimes of greenhouse gases such as methane and carbon dioxide through atmospheric interactions with ozone and OH. Developing an understanding of natural variations in atmospheric nitrogen oxides over the Holocene will aid in the interpretation of long-term records of climate and ecosystem change. One possible source of such information is the record of nitric acid (HNO_3, or nitrate, NO_3^-), the primary sink of nitrogen oxides, obtained from ice cores in polar ice sheets.

We present isotopic measurements of nitrate ($^{15}N/^{14}N$ and $^{18}O/^{16}O$) deposited and preserved in ice at Summit, Greenland. Previous studies have suggested that the $\delta^{15}N$ of nitrate in precipitation contains a source signal while the $\delta^{18}O$ of nitrate contains information regarding chemical pathways of nitrate production prior to deposition. Our measurements from a 100-meter ice core, which contains approximately 300-500 years of climate information, show a large shift in $\delta^{15}N$ between the top and bottom of the core. We discuss the possibility that this shift is indicative of changing sources of nitrogen oxides to the atmosphere over the industrial transition. This would imply that our ice record can be used to evaluate the contribution and extent of influence of pre-industrial sources of nitrogen oxides, providing an important constraint on the interpretation of other records of environmental change.

Trials into the effect of manganese oxide addition to composted municipal solid waste

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Procedure

Trials were carried out into the effects of amending the compost-like output (CLO) from the aerobic digestion of municipal solid waste with varying levels of waste manganese oxides. It was theorised that manganese oxide could affect humification of the decomposing CLO, with potential improvements in carbon storage in the material. Carbon emission data was recorded over the five week period of the study, and E_4/E_6 ratios of a sodium pyrophosphate extraction were measured from CLO samples after five weeks of composting to assess levels of humic matter. Sand was included in the study as a control amendment with the manganese oxide, which was itself a granular material coated onto sand grains.

Results

A statistically significant effect was found between manganese oxide level and carbon flux rate, with flux rate increasing with increasing manganese oxide level. The effect was not significant between all levels however. The level of sand amendment included for comparison was found to be a significant factor only in one of the two trials carried out, where flux rate increased with sand addition. The E_4/E_6 ratio for the CLO extractions were found to be unaffected by the addition of manganese oxide. The absorbancies at both wavelengths (465nm and 665nm) were found to increase significantly with increasing manganese oxide level.

Conclusions

The effect of the manganese oxide was found to have an effect on the rate of flux, although the confounding nature of environmental variations means that further work would be needed to quantify this effect with greater confidence. Attributing the increase in flux rate with manganese oxide to the physical or chemical properties of the amendment is difficult with the data collected to date.

The results from the absorbance analysis suggest that while the degree of humification of the humic matter was unchanged by the presence of manganese oxide, more humic matter in total seems to have been formed.