Horizon-Dependent Effects of Nitric Acid Treated Boreal Forest Soil

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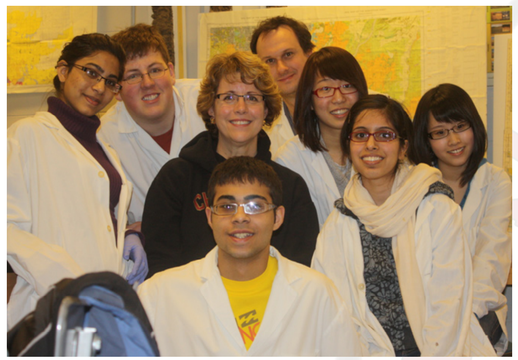


Introduction

- Our experiment was a horizon-dependent analysis of the effects of nitric acid treatment on boreal forest soil.
- Saskatchewan boreal forest soil was used because of its susceptibility to acid deposition carried by prevailing winds from the Alberta oil sands.
-As a result of emissions legislation, sulfuric acid is becoming less of an issue, so we studied the effects of nitric acid.
-This experiment is a continuation of our previous experiment on the effects of nitric acid on the B soil horizon of Quebec boreal forest soil.
- This year we wanted to compare and confirm our previous results and extend our study beyond the B soil horizon.

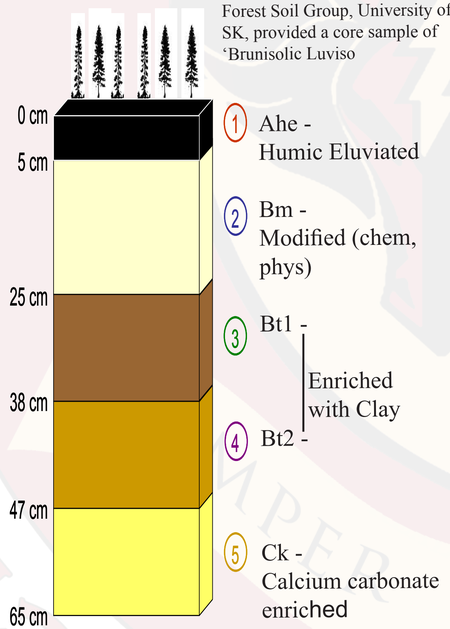
Methods

- A core sample of Brunisolic Luvisol soil was collected by the Department of Soil Science at the U of S from Keeley Lake, Saskatchewan.
- The core sample included the Ahe, Bm, Bt_1, Bt_2, and Ck soil horizons.

Experiment

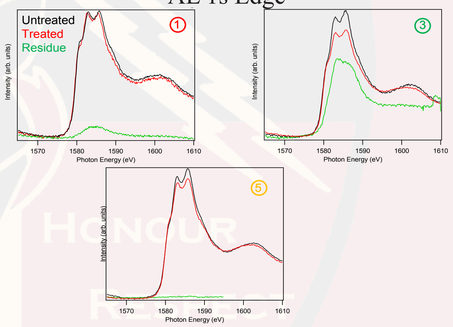
- Used Soft X-Ray Absorption Spectroscopy to investigate the soil using the SGM beamline at the Canadian Light Source.
- Focused on aluminum to compare the effects of nitric acid on Saskatchewan boreal forest soil in the B horizon as opposed to our previous experiment which was done with Quebec boreal forest soil. (C.M. Minielly et al.)
- Compared the B horizon to the A and C horizons.
- Broad scans were taken to identify the other elements being affected, and to observe possible depth-dependent effects.

Boreal Forest Soil Profile
Forest Soil Group, University of SK, provided a core sample of 'Brunisolic Luviso



Each layer was numbered in order to easily identify the layers in our scans.

AL 1s Edge

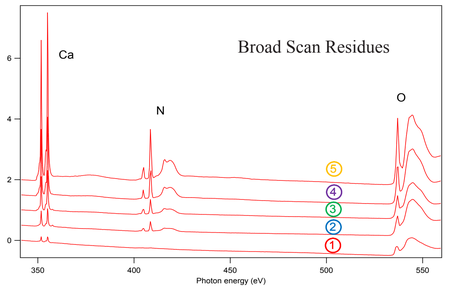


- Aluminum was affected in layer three (Bt1) confirming our previous results on Quebec boreal forest soil (C.M. Minielly et al.)
- Layers one (Ahe) and five (Ck) are much less affected.
- This suggests potential buffers protecting aluminum in the top and bottom layers.

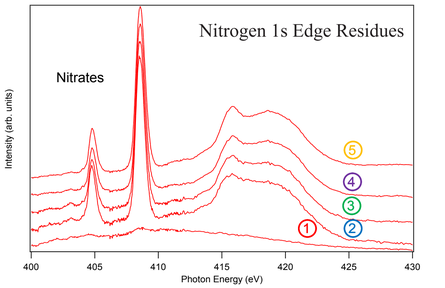
Soil Preparation

-We decided to "shock" the soil using 0.5 molar nitric acid solution, a pH that is lower than would fall as precipitation, in order to exaggerate the potential effects and make them more easily detectable.
-We shocked each layer independently.
-We mixed a 1:1 ratio of 3g of finely ground soil: 3mL acid. We placed the mixture in tubes and shook them at 160 RPM for 2 hours.
-Soil and filtrate were dried in a vacuum drier at room temperature.

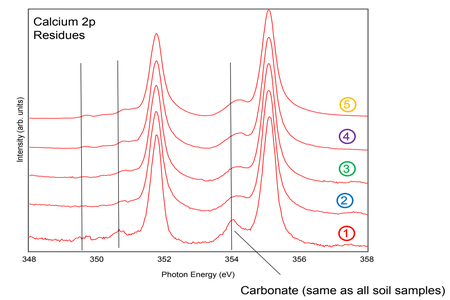
- A broad scan of different edges shows the residues which tell us what has been removed from the soil.
- There is not much change in the residue of layer one (Ahe).
- Increasing amounts of calcium and nitrogen appear as we go deeper.



-Layer one (Ahe) does not show much change.
-In the other layers, the scans show the unique chemical fingerprint of nitrates.
- This suggests that there might be a reaction taking place in the soil.
-Layer one (Ahe) —No effect on either aluminum and nitrogen.
-Layer Five (Ck)—No effect on aluminum; nitrogen is affected.
- This suggests two different buffering mechanisms in the top and bottom layers.



- Layer one (Ahe) shows the unique fingerprint of calcium carbonate.
- The two big peaks identify the calcium and the three black lines identify carbonate in layer one (Ahe).
- The carbonate peaks in the other layers shifted and have become the reaction product of something else.
- We suspect that the calcium carbonate has reacted to form calcium nitrate.



Conclusions

Nitric acid has an effect on soil.

- The effects are depth dependent.
- There are two different buffering mechanisms that protect aluminum in the top (Ahe) and bottom (Ck) layers.
- We suspect that the buffer in layer five (Ck) is calcium carbonate.
- Layer one (Ahe) may be buffered by organic material.
- OR the top layer (Ahe) might already have been affected by previous exposure to acid deposition.

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