Study of Spatial Deposition of Seven Contaminants from the Oil Sands Industrial Processes into the Wood Buffalo Region

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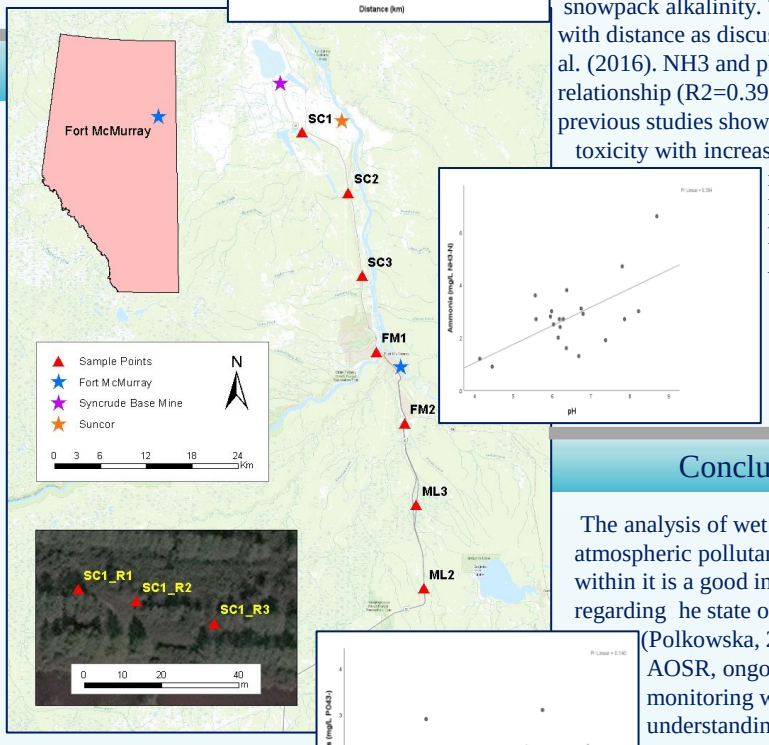
Abstract

Snowfall has the ability to accumulate contaminates and the analysis of the snowpack can provide data regarding the airborne pollutants in the air (Kirk et al., 2019). This data allows us to predict the airborne pollutants present in the area and the concentration of the pollutants accumulated by the snow. Our study focuses on pollutants from Oil Sands mining operations North of Fort McMurray and how they spread throughout the region (Kirk et al., 2019). Using the results from our analysis we were able to hypothesize the origin of the contaminants found in the snowpack and the spread of pollutants from Oil Sand mining operations.

Introduction

The Athabasca Oil Sands Region (AOSR) encompasses the city of Fort McMurray and is the third largest oil reserve in the world containing 170 billion barrels of recoverable bitumen (Harner et al., 2018). Industrial process in the AOSR enhance atmospheric deposition of pollutants that affect local vegetation, wildlife, and human health (Kirk et al., 2019). The focus of this research is to examine the southern extent of contaminants originating from AOSR within the Wood Buffalo region, which are then deposited through snowfall. Snow samples were collected in a linear north-south pattern following highway 63 through the city of Fort McMurray to measure the amount of airborne pollutants accumulated in the snowpack. Understanding the accumulation of pollutants at varying distances from the city of Fort McMurray will provide evidence for future studies on contamination concerns in snow melt from the AOSR.



Methodology

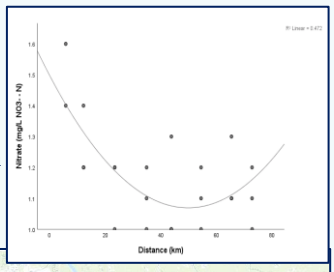
Three snow sampling replicates were collected at eight locations with a mean distance of 9.1 km increments from the main oil sands operations:

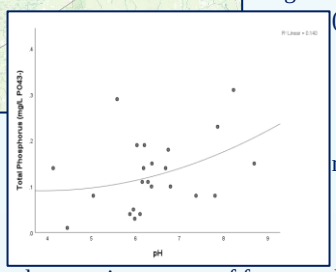
· 3 locations were chosen South of Syncrude Canada LTD.
· 2 locations were chosen within the city of Fort McMurray limits
· 3 locations were chosen within Maqua Lake

Samples were collected 100m perpendicular to main roadways. Sampling equipment was decontaminated with 2% FL-70 detergent followed by hexane. Data on local weather conditions, snow depth, time and habitat type were recorded on site. Samples were stored frozen until testing in the lab commenced. The lab analysis included pH, electroconductivity (EC) and the detection of the following contaminating species: NH3, NO3-, NO2-, Si, SO42-, S2-, TN, TCr, TP. Some limitations we encountered include accessibility to suitable sites for snow sampling which forced us to collect samples close to Highway 63 North and South of Fort McMurray.

Results

A moderate correlation between NO3- and distance was observed (p-value=0.15) indicating higher concentrations of NO3- closest to the AOSR and decreasing towards Fort McMurray. A weak correlation between TP and pH was observed (p-value=0.092). Literature supports this relationship as studies have shown an increase in TP concentration corresponds to increasing snowpack alkalinity. TP also decreased with distance as discussed by Summers et al. (2016). NH3 and pH showed a strong relationship (R2=0.39; p-value=0.014); previous studies show NH3 increases in toxicity with increasing pH (direct relationship). Both NH3 and pH were highest near the AOSR.





Conclusion

The analysis of wet deposition and the atmospheric pollutants contained within it is a good indicator to look at regarding he state of the environment (Polkowska, 2011). In the AOSR, ongoing and systematic monitoring will lead to the understanding of the spread of pollutants around the Oil Sands region north of Fort McMurray. With the implementation of long term, standardized analytical and sampling procedures, point sources of future and ongoing contamination can be identified (Polkowska, 2011). Understanding the ability of snow to trap and transfer air pollutants can allow us to estimate the spread of pollutants during the winter This study can provide valuable information pertaining to how snow can collect and transfer airborne pollutants. This information can be used to predict pollutant levels in snowfall and possible contamination of fresh water due to the accumulation of these pollutants in snowfall. With the introduction of frameworks and air quality standards to extensively reduce pollution, it will result in the enhancement of the health of our earth.

Acknowledgments

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