Contamination in the Precipitation

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We are a group of high school students attending Notre Dame High School in Calgary Alberta. We were interested in looking for the presence of various contaminants in samples of snow collected from areas in Alberta and British Columbia.

Sample Collection and Preparation

We chose specific locations based on their exposure to different levels of potential contamination. Our areas included samples from urban areas, factories, and ski resorts. We hypothesized that acquiring several samples from different places within Alberta and British Columbia would allow us to see the difference in contaminants in relation to the amount of human activity in each specific location. Our samples were then prepared and the acquired precipitate, scraped into cuvettes to later transfer them into sample holders at the Canadian Light Source (CLS).

Using the IDEAS beamline, we utilized two techniques to determine the contaminants present in our samples. The first technique being X-ray Fluorescence Spectroscopy (XRF), which measures the fluorescent x-ray emission from a sample after it has been excited by a primary x-ray. Since each element has a unique fluorescent "fingerprint" it allowed us to determine the elemental composition of our samples.

The second technique being X-ray Absorption Near Edge Spectroscopy (XANES), which determines chemical speciation. With XANES we were able to acquire more detailed information about the chemical speciation of certain elements found in our samples.

The XRF scans revealed that there was little to no heavy metal contaminants of concern in the majority of our samples. However, amounts of Arsenic were found in many areas as well as Zinc.

From our results, we determined there was a presence of Zinc and Arsenic (V) in multiple locations across Alberta and British Columbia. Only relative levels of these elements were able to be determined. The presence of Arsenic (V) can be of concern as it may have the ability to accumulate into groundwater. This may pose a threat to humans as it has bioavailability potential.

We would like to thank Dr. R. Blyth Dr. D. Muir, A. Boechler, G. Walker, T. Walker, all whom made this ambition of ours a reality, NSERC PromScience, as well as our dedicated teachers Mr. D. Giers and Dr. C. McCloskey.

The higher relative concentration of Zinc, lead us to choose to do further XANES. The samples from Calgary, Edmonton, and a ski resort appeared to indicate the presence of either Zinc Sulfate or Zinc Nitrate, while Calgary tap water and the oil upgrader in Fort McMurray show the presence of Zinc Chloride. This likely has to do with human activity in and around the areas tested. Zinc Sulfate and Zinc Nitrate are released by automobile use. Zinc Sulfate can lead to sickness in large concentrations, but Zinc apparently is not concentrated enough in snow to pose any real danger to humans. Zinc Chloride is extremely soluble in water, and is likely ubiquitous in all our snow samples.

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