MAY THE FOREST BE WITH YOU

Saint Thomas More Collegiate: Maya Becher, Olivia Becher, Victor Chen, Beatrice Gonzales, Tess Grindlay, Gabe Manansala, Yousef Mian, Joshua Onukwulu, Julianna Pathyil, Mackenzie Pereira, Ryan Rizzo

Canadian Light Source | Centre canadien de rayonnement synchrotron

Introduction

In British Columbia (BC) , we've recently experienced recurring forest fires. Throughout the past few years our skies have been filled with harmful thick black smoke. Additionally, the forestry industry makes a big impact on BC's economy. Due to the environmental and economic relevance to our province, we decided to study how forest fires can affect trees in BC. In preliminary research, we found that elements such as Zinc, Calcium, Arsenic, Iron and Manganese were present in forest fire ash. Through our study, we wanted to learn how the presence of these elements might affect the surrounding trees.

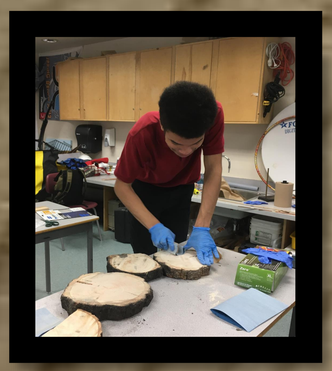
Sources: BC Stats; British Columbia's Forest Industry and the BC Economy in 2016, PCW; Labour Force Survey, BC Stats; Economic State of BC Forest Sector, BC Stats: 2018 Budget Estimates, BC Budgets

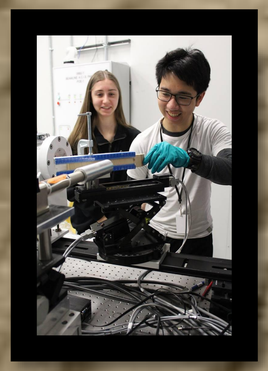
Source: cbc.ca

Source: thestar.com

Our Question

Are the elements common in forest fire ash (As, Fe, Mn, Ca, Zn) more present in the chemical composition of the tree rings of Douglas Firs (Pseudotsuga menziesii) after a forest fire?





Process

The Douglas Fir was chosen due to its abundance in our province, as well as its thick, fire resistant bark. We received tree cookies from BC forestry companies – Tolko, Interfor and Canfor. Sample processing went as follows:

1) **Drying**
It was necessary to dry the samples before we began sanding to ensure that enough water had evaporated from the samples for them to be useable on the beamline.

2) **Sanding**
We sanded our samples using both sandpaper and a mechanical sander so that we could see rings more clearly.

3) **Counting**
The number of rings on a tree reflects its age. We counted rings both manually and digitally.

Figure 1: Image of iMap BC, with a coordinate point of one of our samples.

4) **iMap BC**
We plotted the coordinates that were provided to us by the forestry companies into the government's online data resource (Figure 1) , and then cross-referenced it with the age we had determined from counting. This allowed us to determine if our tree samples had been exposed to a forest fire.

5) **MAD Lab**
At the Mistik Askiwin Dendrochronology Laboratory (MAD Lab) located at the University of Saskatchewan, we were able to do further counting of our samples. With the technology available at the MAD Lab, we found the distance between each tree ring, and a more exact age of each tree.

6) **IDEAS Beamline**
The Beamline we used for our experiment was the IDEAS Beamline. Data was collected using XRF (X-Ray Fluorescence Spectroscopy), which determines the elements present in a sample by testing the sample at regular intervals. We conducted line scans, which involve a series of XRF scans every millimeter along the sample, for eight seconds each.

Results and Conclusions

Conclusion #1

After examining the results from our experiment on the IDEAS beamline, we noticed that recurring peaks appeared on our line graph data (Figure 2). They indicated that the amount of Zinc, Calcium, Arsenic, and Manganese had increased. These increases aligned with the years following known fire years, which we had determined through tree ring counting conducted at the MAD Lab.

Legend (Figure 2)

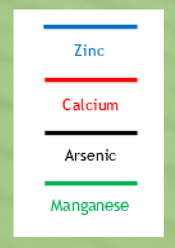
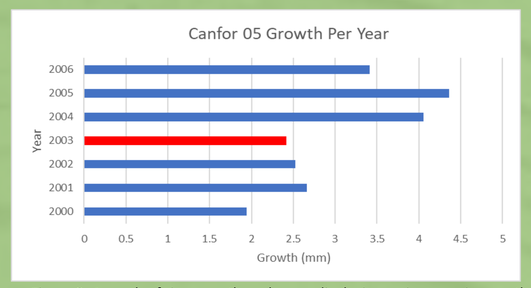


Figure 2: Line graphs of amounts of various elements in a burned Douglas fir tree

Conclusion #2

While examining the distances between tree rings in the MAD lab, we noticed that a trend stood out. In many of our samples, there was a significant increase in tree ring width in the 2-3 years following a forest fire. (Figures 3 & 4) We looked into this further and found a few studies that supported this finding, and they suggested that a likely cause for this occurrence could be as a result of decreased competition after a devastating fire.

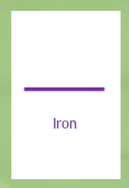


Legend (Figure 3 & 4)

Figure 3: A graph of ring growth each year, displaying an increase in growth in years following a fire.

Figure 4: A graph of ring growth each year, displaying an increase in growth in years following a fire.

Legend (Figure 5)



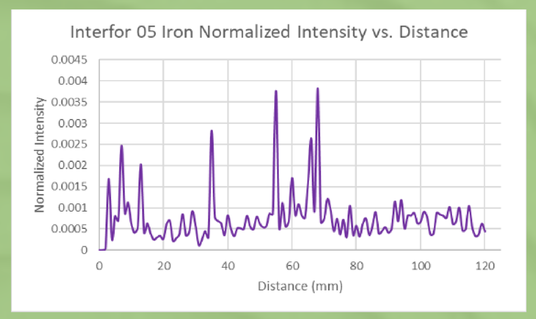


Figure 5: A line graph which shows many increases in the iron present in this unburned Douglas fir.

Conclusion #3

We also noticed unexpected increases in Iron in many of our samples. (Figure 5) This is an area for further research because we can only guess what the cause of these increases may be. Some possible explanations could be human industrial impacts or the type of soil present at the sample's location.

Acknowledgements

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