A description of the environmental impacts of mining near Butte, MT via biomonitoring.

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Introduction

In the 1880s, Butte, Montana was home to one of the richest mineral deposits in the world. Today, the region is home of two of the most toxic superfunds sites in America, the Anaconda Smelter Site and the Berkeley Pit.
The goal of this analysis is to quantitatively determine the baseline level of heavy metals accumulated adjacent to the superfund sites. In order to sample and describe past and present air pollutant emissions we employed biomonitoring and dendrochronological techniques on Lodgepole Pine trees.

Figure 1. The Berkeley Pit. This pit is constructed North of the city of Butte Montana, and was created for the purpose of copper extraction. It is no longer a functioning mining site. Retrieved from https://www.google.ca/maps/@46.0444707,-112.6526318,57858m/data=!3m1!1e3 .

Methodology

Pine needle, bark, and tree core samples were collected from the Elk Park area North of the Berkeley Pit and West of the Anaconda smelting site. The needles and bark were dried, weighed and ashed in a muffle furnace. Tree cores were dated and cross compared using the tree rings, then treated in the same manner as the previous tree components.
The samples were digested and analyzed using Inductively Coupled Plasma-Mass Spectrometry (ICP-MS).

Figure 2. Tree Core Sampling. Needles, bark, and tree cores were collected from 8 trees on two hills within Elk Park.

Results

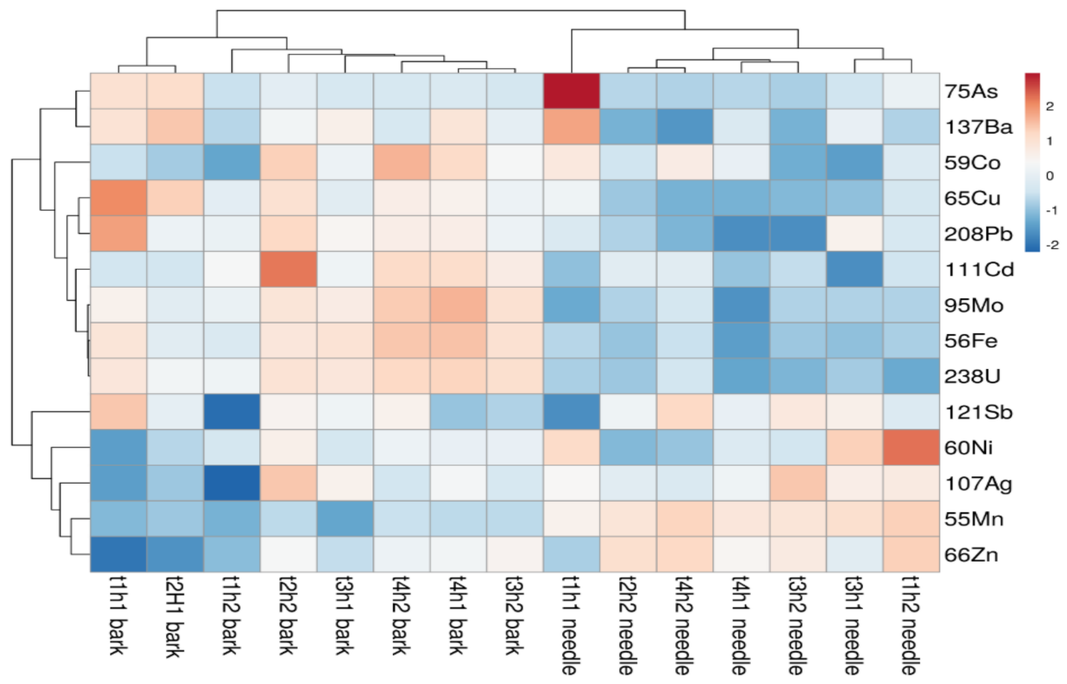

Figure 3. Heat Map of Bark and Needle Samples. This figure displays the log transformed metal concentrations of the bark and needle samples as well as their grouping based upon Principle Component Analysis.

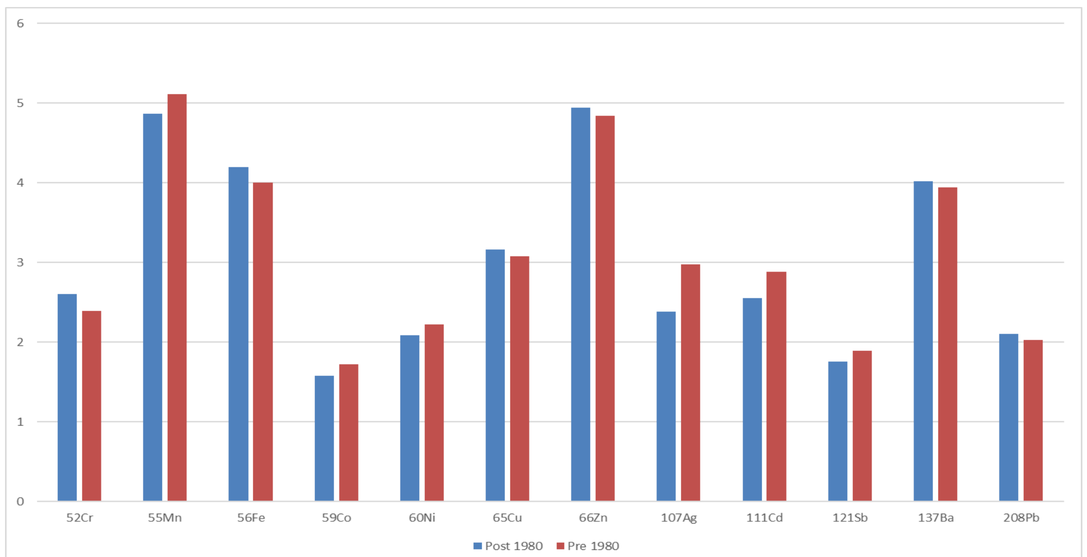

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Figure 4. Composite Core Data. This figure displays the log transformed composite tree core concentrations for all samples prior to 1980 and post 1980. The differences between Mn, Ag, and Cd are significant ($p<0.01$); Ni significant ($p<0.05$); via One-Way Anova and Tukey HSD test.

Discussion

Pine needles and bark samples indicate a relatively high level of heavy metals; one needle sample exhibited over 50ppm of Arsenic. Core samples demonstrate a significant decrease post 1980 across many of the heavy metals tested for; this may be due to the closing of the Anaconda Smelting Site in the late 1970's. This difference may become more pronounced with the rerun of several samples due to unresolved drift and stability issues with the ICP-MS. The baseline established this year will be helpful in determining if current changes (Fall 2018) and remediation practices being conducted on the Berkeley Pit positively or negatively impact air quality in the region.

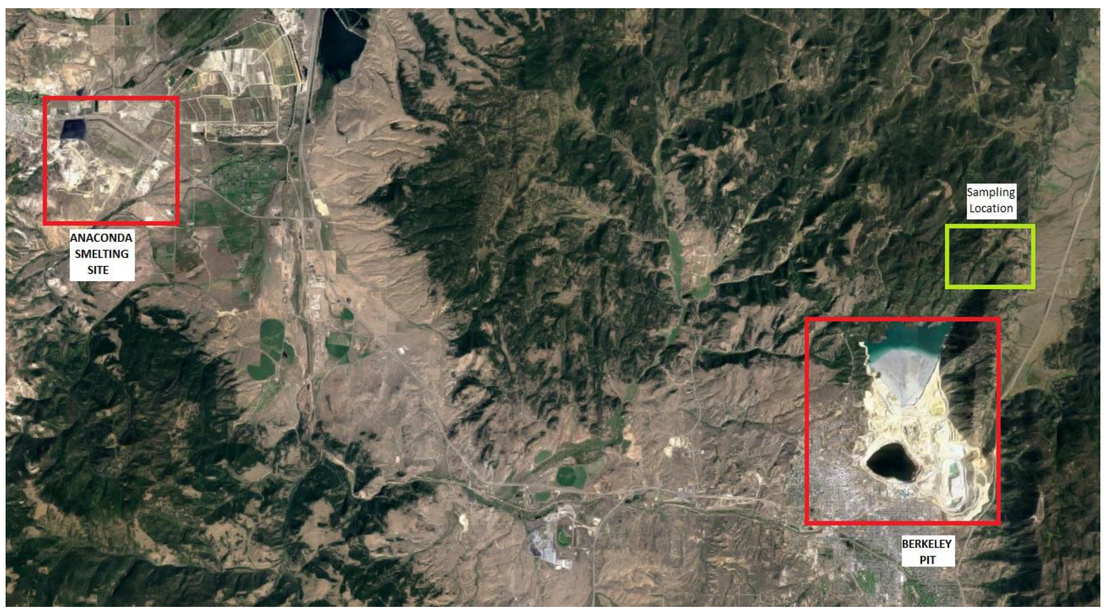

Figure 5. Superfund Sites and Sampling Location. Retrieved from https://www.google.ca/maps/@46.0444707,-112.6526318,57858m/data=!3m1!1e3.

References

Speer, J. H. (2010). *Fundamentals of tree ring research.* Tucson, AZ: The University of Arizona Press.