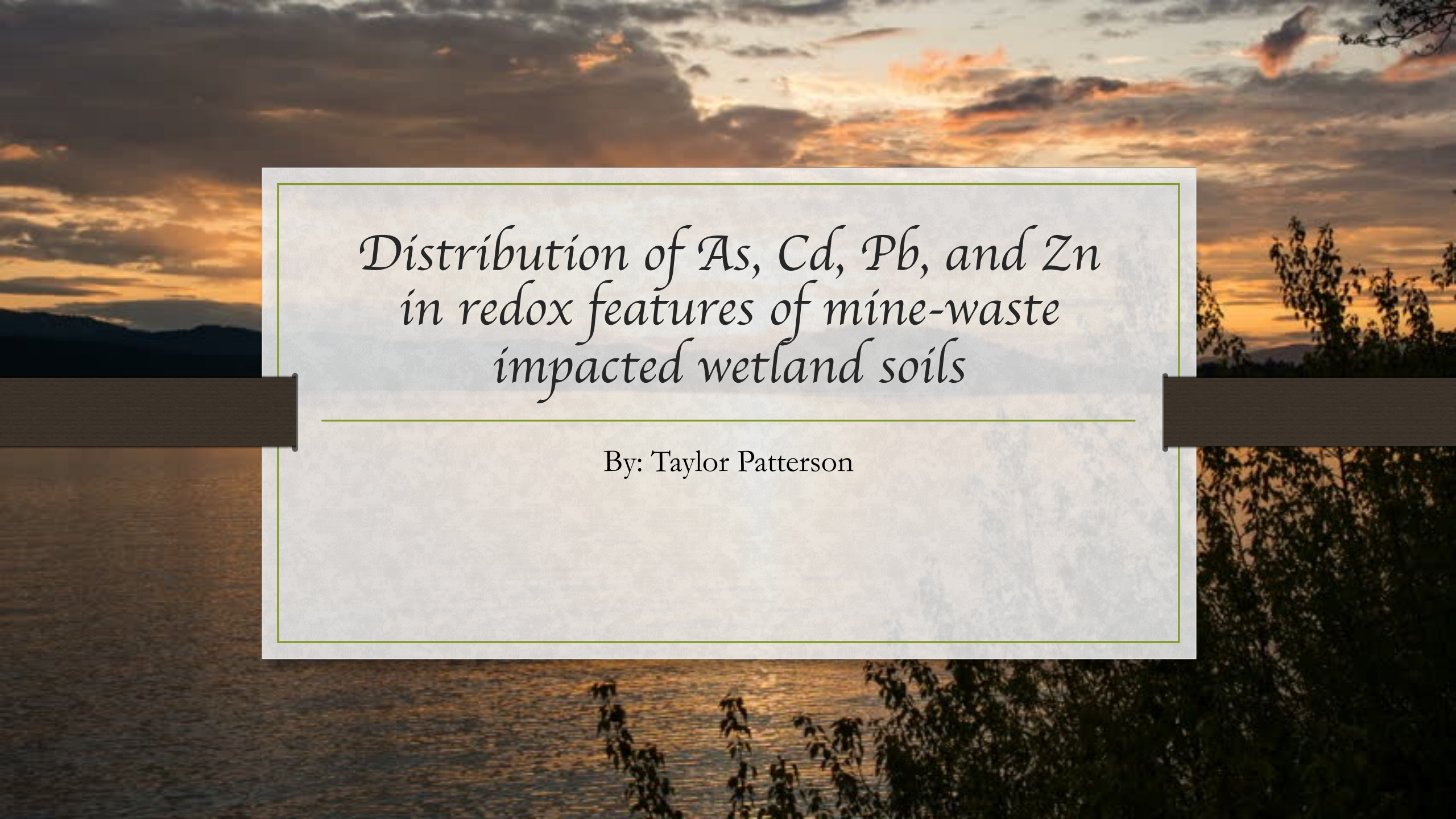
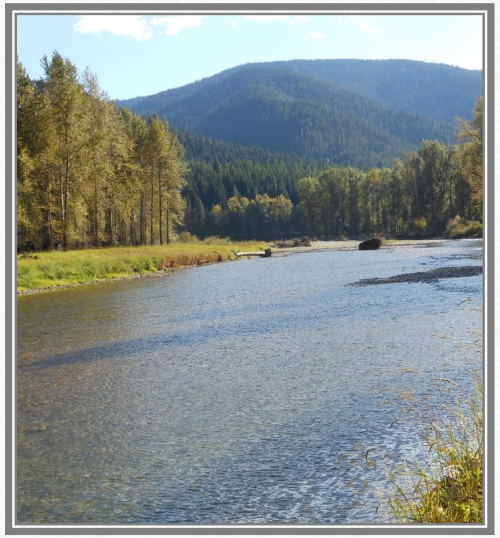
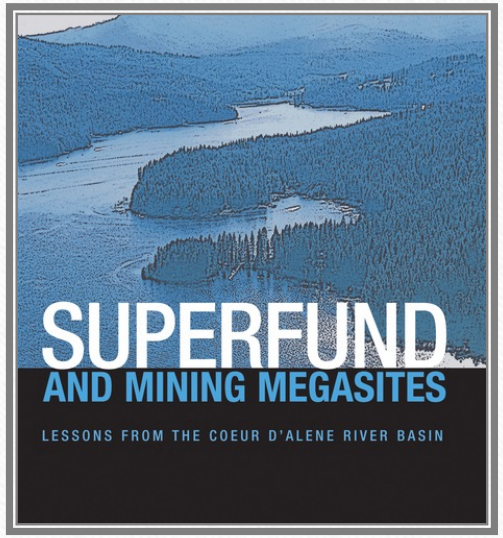


Distribution of As, Cd, Pb, and Zn in redox features of mine-waste impacted wetland soils

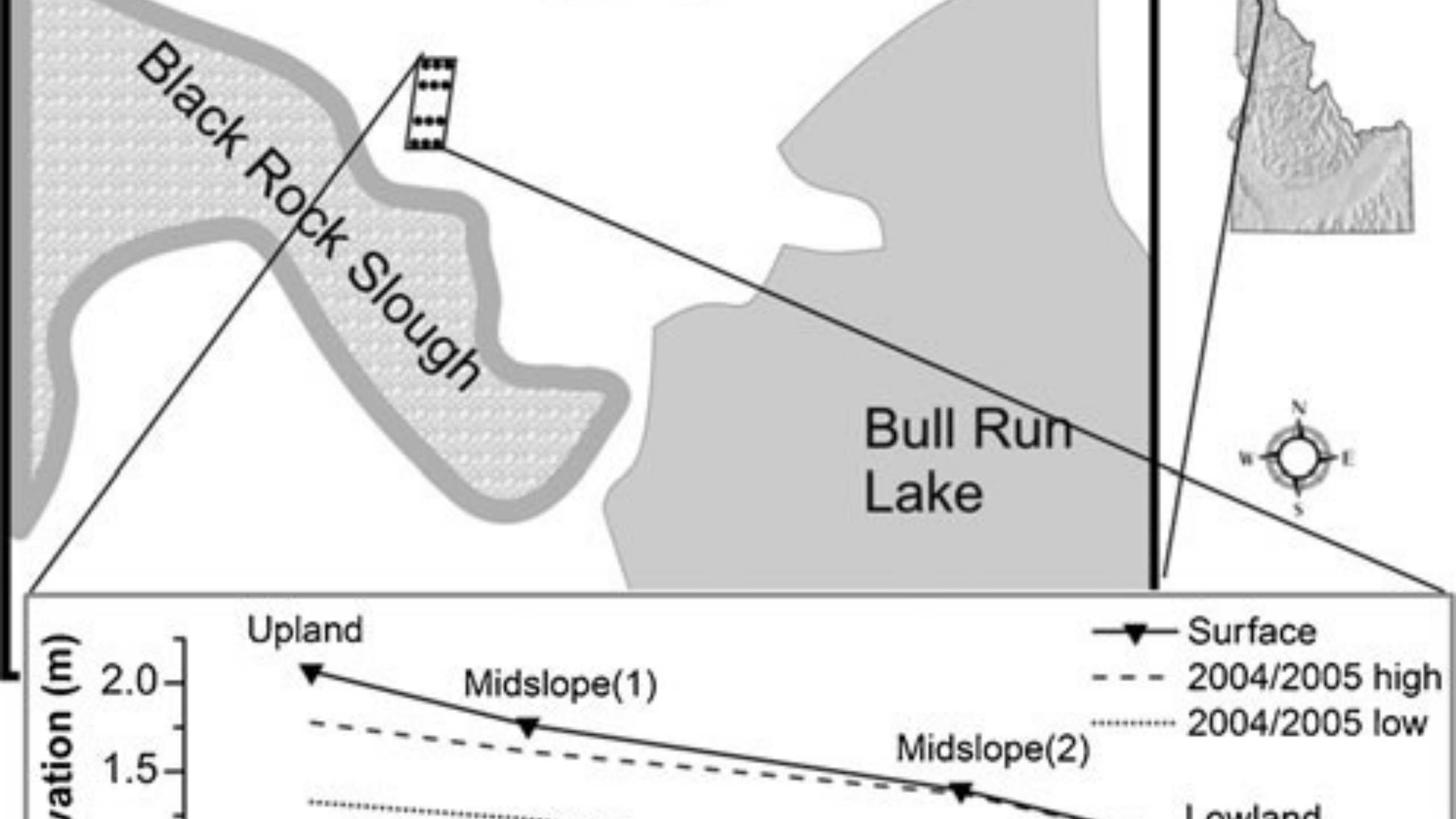
By: Taylor Patterson

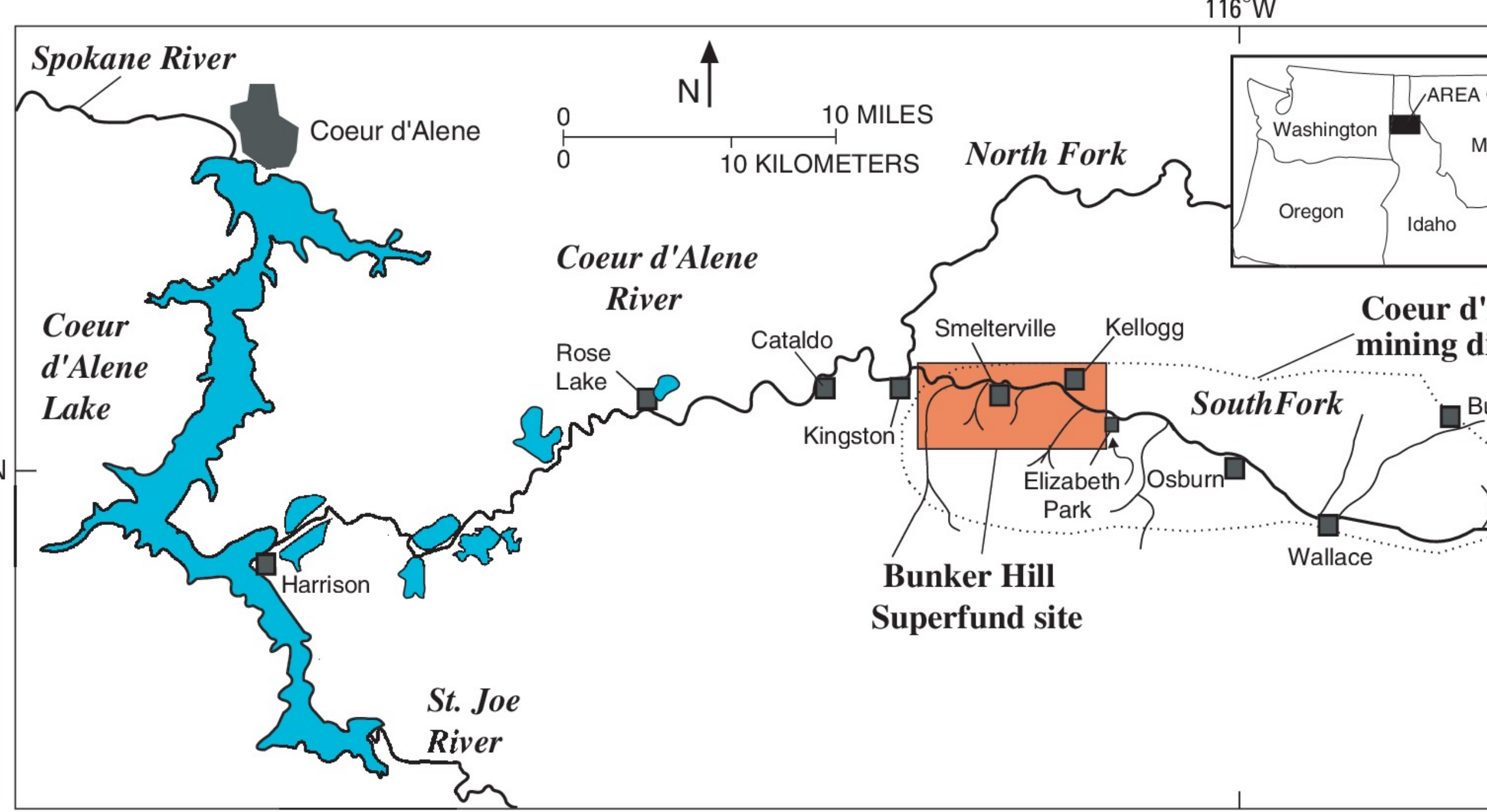
Purpose





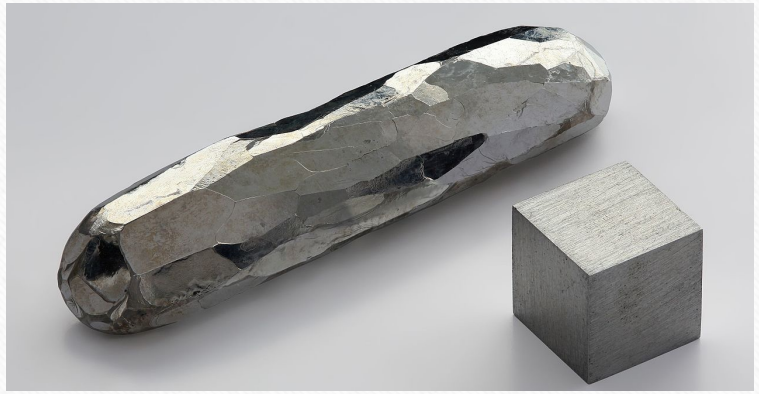
- Wetland soils of the Coeur d'Alene (CdA) River Basin of northern Idaho, USA contaminated with toxic elements released during mining activities.
- This Paper includes the extensive multi scale investigation of total As, (Arsenic), Cd (Cadmium), Pb (lead) and Zn (Zinc) distributions along a transect of these contaminated soils.


Black Rock Slough
Bull Run
Lake
N
W
E
S
Upland
Midslope(1)
Midslope(2)
Lowland
Surface
2004/2005 high
2004/2005 low
2.0
1.5


116°W
Spokane River
Coeur d'Alene
N
0
10 MILES
0
10 KILOMETERS
North Fork
Washington
AREA
Oregon
Idaho
Coeur d'Alene River
Coeur d'Alene Lake
Rose Lake
Cataldo
Smelterville
Kellogg
Coeur d'
mining di
Kingston
SouthFork
Elizabeth Park
Osburn
Wallace
Harrison
Bunker Hill Superfund site
St. Joe River

Introduction

- The Coeur d'Alene (CdA) River Basin in northern Idaho contains 11 lateral lakes and thousands of acres of associated wetlands. As a result of the upstream mining activity and redistribution of the mine and milling materials via erosion, stream transport and downstream floodplain deposition,The wetland soils in the CdA river basin are heavily contaminated with As (Arsenic), Cd (Cadmium), Pb (lead) and Zn (Zinc) along with other elements.
- There is toxicity risk to wildlife in the surrounding area and perimeter of the basin as well as human health concerns exposed through recreational and agriculture activities in the region.
- Soils in the wetlands along the river are subject to seasonal fluctuations in temperature and water table depth, which causes changes in the soil redox potential. These variations have led to the formation of redox features.
- These formations have also led to heterogenous concentrations of Fe (Iron) and Mn (Manganese) oxides, such as cemented soil aggregates and red and gray mottled soil colors.
- Only a few studies have investigated the distribution of these contaminants in soils that undergo the repetition stage of the wetting and drying cycles.



Methods

- A transect was established 78m in length (255 feet) at Black rock Slough along and elevation gradient (Bull run lake is neighboring the Cda River).
- Four sampling points were designated upland, midslope 1, midslope 2, and lowland to get proper measurements. Upland point was 110m from river edge and lies on the backslope of the levee and lowland point was 190m from the river edge and is in a lateral marsh (backswamp).
- To monitor the water table fluctuations 2.4-5m long slotted plastic sleeve wells were installed at each site.
- During this course of study soil redox potentials were not measured, instead the surveyors relied on the presence/absence and expression of redoximorphic features to infer general redox conditions.
- The surveyors used features resulting from Fe reduction, translocation and accumulation as evidence of fluctuating soil redox potentials that facilitate Fe and Mn oxidation and reduction cycles.
- The surveyors also did throughout this process, Soil separate sampling methods, bulk soil method and statistical analysis

Results

- The Black Rock Slough study site is a wetland environment, the elevation change between the upland and lowland site is 1.1 m with an overall 2% slope.
- The water table depth varies throughout the season and how much rainfall is accumulated through out those months. Between September 2004- August 2005 the highest month for water accumulation was May.
- The A horizons of the soils are relatively dark, with red to orange hues and redox features such as mottling and cemented aggregates.
- All the soils in the Black Rock Slough wetland are significantly elevated in contaminants compared to the pre mining sediments. The surface horizon soils at the two upslope sites have greater contaminant concentrations than the surface horizons of the lowland sites.
- Charcoal was found in the surface horizon soils but was explained by surveyor's that when the sample was taken it looked to be as if a fire was once started there.

Conclusion

- Analysis of the contaminant distribution in wetland soils at spatial scales spanning three orders of magnitude provides insight into how redox cycling affects contaminant fluxes.
- It is hypothesized from this experiment that contaminant redistribution occurs by redox driven dissolution and reprecipitation of Fe (Iron) and Mn (Manganese) Oxides. (Being dispersed through the clean soil)
- In the CdA River Basin, there are over 18,000 acres of contaminated wetland soils, much due to varying degrees in saturation.
- There are several problems with this strategy, One: continuation of flooding may re contaminate the surface horizon and Two: Repetition of the wetting and drying cycle occurs, redox gradients will facilitate movement of the contaminants to the remediated areas and burying the contaminated soil with the clean soil making sites with fluctuating water tables poor remediated sites in the future.

Questions?

- What are the elements that are contaminating the Cda river? And why are they concerning?
- Why do we care so much about a wetland?
- What is a superfund site? How does something become a Super Fund Site?

References

- Strawn, D. G., Hickey, P. J., McDaniel, P. A., & Baker, L. L. (2012). Distribution of As, Cd, Pb, and Zn in redox features of mine-waste impacted wetland soils. *Journal of Soils and Sediments*, *12*(7), 1100-1110.
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