How Metal is Your Campus? Vol IV

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Introduction

- Human activity such as land development can deposit toxic metals in the environment, including lead and zinc (1).
  - Metals can be absorbed, inhaled or ingested from contaminated soil, food, water, and air.
  - Toxic metals can accumulate in plant and animal tissues.
  - Toxic metals can cause negative health outcomes among humans - lead and zinc for example can cause adverse neurological effects.
  - It is important to be aware of and minimize the effects of these toxic substances and find ways to reduce contamination of highly populated areas under development.

Research Questions and Hypothesis

Is there a significant difference in the metal content around a construction site compared to a controlled soil site away from the construction?

If construction work deposits harmful metals onto nearby plant tissues & soils, then plant tissues & soils nearby a construction site will contain higher quantities of these metals than plant tissues & soils from undeveloped land.

Methodology

- Two sample sites; near a construction zone (E) and at the Desert Restoration Zone (C).
- Six samples along six transects taken in grid formation at both sites (Figure 1).
- Leaf samples collected from nearby mesquite trees at both sites.
- Leaf samples were dried and soil samples were sifted for unwanted debris.
- Leaf samples were ground into a fine power and analyzed by X-ray fluorescence (XRF).
- All soil samples analyzed by XRF (Figure 2).
- T-tests conducted to analyze for significant differences in harmful metals in leaf and soil samples (α = 0.05).

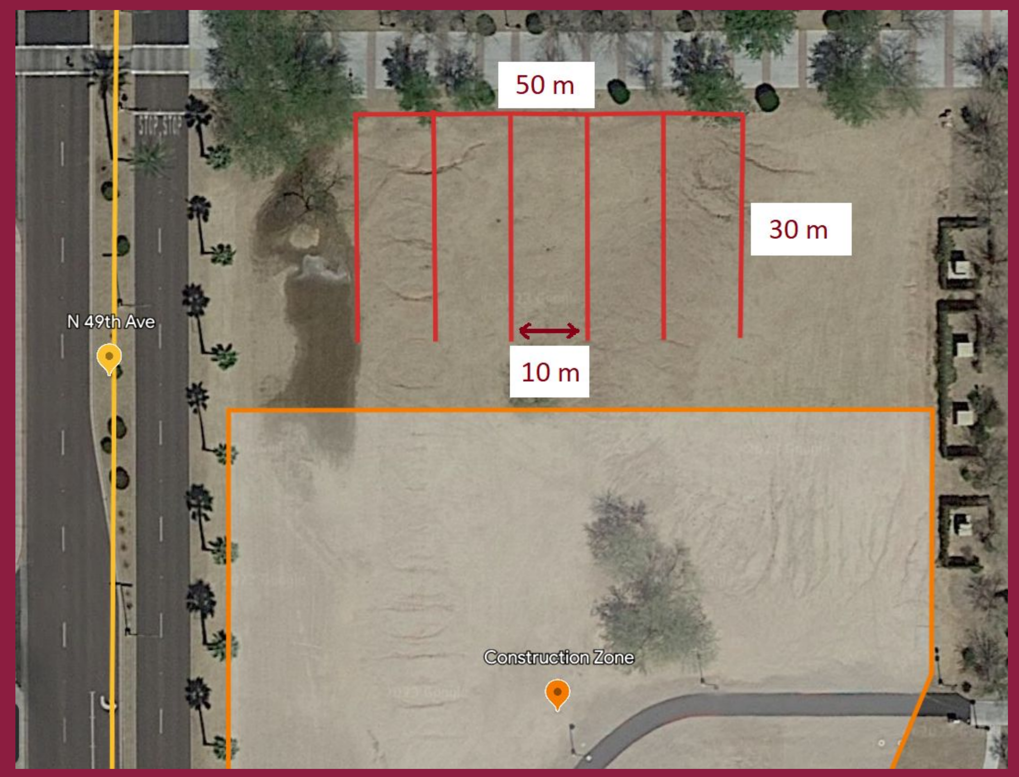

Figure 1: Transects at the experimental site. An identical series of transects was made at the control site in ASU West's Desert Restoration Zone.

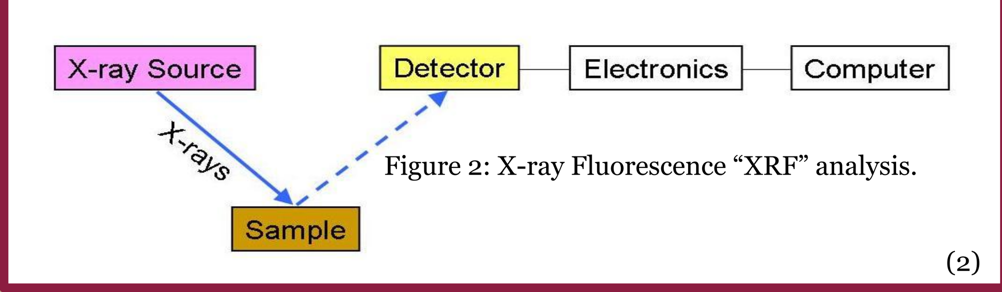

Figure 2: X-ray Fluorescence "XRF" analysis.

QR Code to Data!

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Results

- Significant differences in metal content were observed between control and experimental soil samples (Table 1).
  - In addition to potentially toxic metals, quantities of calcium, magnesium, potassium, and sodium differed significantly as well.
- Mesquite leaf samples did not differ significantly except that control trees contained greater quantities of arsenic.
  - Control: 0.0291 m/m% vs. experimental 0.0100 m/m% (T-test: 0.01839)

Soil Results

	Mean Control (m/m%)	Mean Experimental (m/m%)	T-Test
Iron	6.0517	5.4253	$3.3605 * 10^{-7}$
Titanium	0.5716	0.658	$1.093 * 10^{-9}$
Barium	0.1418	0.1777	$1.6586 * 10^{-4}$
Cobalt	0.0861	0.0729	$1.6053 * 10^{-7}$
Manganese	0.0951	0.1294	$2.8241 * 10^{-7}$
Strontium	0.0782	0.0647	$1.2765 * 10^{-4}$
Vanadium	0.012	0.0062	$1.1675 * 10^{-6}$
Rubidium	0.0152	0.0197	$2.8122 * 10^{-4}$
Chromium	0.0099	0.0049	$1.9201 * 10^{-6}$
Zinc	0.0128	0.0158	$1.426 * 10^{-3}$
Nickel	0.0067	0.0015	$< 1.0 * 10^{-10}$
Copper	0.0058	0.0017	$< 1.0 * 10^{-10}$
Niobium	0.0002	0.0041	$5.232 * 10^{-10}$

Table 1: Metals in yellow have higher concentrations at experimental than control site. Metals in grey have lower concentrations at experimental than control site.

Discussion

- Results suggest that differences in soil metal content were likely due to landscaping/addition of gravel, rather than proximity to construction zone.
- For mesquite trees, results suggest that surface soil metal content does not significantly impact mesquite leaf tissue metal content.
  - Mesquite trees are phreatophytes, which rely primarily on a taproot that reaches the water table for nutrients (3). Metal deposition on surface soil would therefore not likely be absorbed.
- Arsenic content in control mesquite samples likely reflects natural arsenic content of Arizona soils (4) and accumulation over time.
  - Future research could focus on potential of mesquite trees for arsenic remediation.

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NIH National Institutes of Health

ASU Arizona State University

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Citations

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