# The micro-scale distribution of Lead (Pb) and its bioavailability in contaminated soils at Tyndrum

## Background

The European Soil Thematic Strategy identifies local soil protection as an important issue[1]. 2.5 million land sites in the EEA-392 contain potentially harmful elements (PHEs)[2]. To manage these sites and mitigate the risk to the environment and human health, it is important to understand the dynamics of PHEs as influenced by soil properties.

## Objectives

1. Identify the effect of PHEs on soil structural development.
2. To observe how soil structure and the micro-scale distribution of contaminants within aggregates influence the bioavailability of PHE.

**Figure 1.** Historical mining and processing site, Tyndrum.

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# Methodology

**1 Sample Collection**
Samples were taken from three sample sites down steam along the floodplain. At each sampling site, three replicate samples of undisturbed soil were taken.

**2 Sample Preparation and Measuring Soil Properties**
The samples were wet sieved into four aggregate size classes; >2000 µm, 250-2000 µm, 53-250 µm, and <53 µm. Bulk density, pH, organic matter content and particle size and distribution were measured.

**3 Measuring Total and Exchangeable Metal Concentration**
The soil aggregate classes were leached in EDTA solution to measure the exchangeable metal concentration and were digested in conc HCl and conc $HNO_3$ to estimate the total metal concentration.

**4 Data analysis**
The association between the variable groups were analysed by ANOVA. Additionally, linear regression was used to explain the relationship between total and exchangeable metals.



# Results

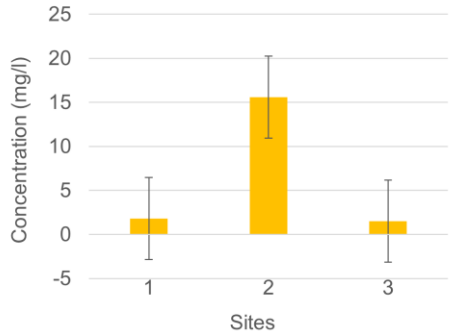


**Figure 2.** Average total Pb concentration at each site.

**Table 1**. Soil properties at each site.

| Site | Bulk density ($g/cm^3$) | pH+$CaCl_2$ | Organic matter content (%) |
|---|---|---|---|
| 1 | 0.957 | 4.10 | 36.9 |
| 2 | 0.927 | 3.57 | 32.3 |
| 3 | 0.752 | 3.70 | 20.7 |

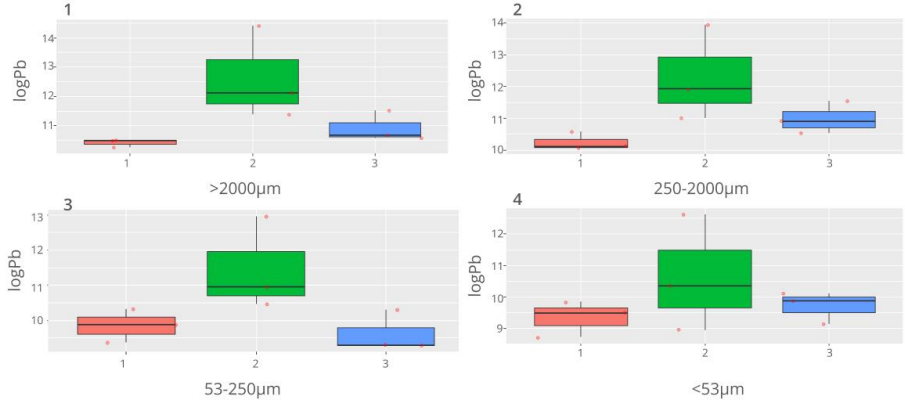


**Figure 3.** Kruskal-Wallis Test. The differences in exchangeable Pb concentration among the different aggregate classes ($H_1$=6.49 $df_1$=2 $p_1$=0.04 | $H_2$=5.69 $df_2$=2 $p_2$=0.06 | $H_3$=5.96 df3=2 $p_3$=0.05 | $H_4$=1.87 $df_4$=2 $p_4$=0.39 ).

# Conclusion

- The total Pb concentration is significantly different among the sites although the soil characteristics are similar. This indicates the higher metal concentration does not impact the soil structure. Although there is a clear difference in the vegetation development in site two.
- There is a relationship between the aggregate size and the exchangeable metal concentration. Compared to the high difference in the total metal content among the sites, the variation between the classes is not strongly significant. Hence the bioavailability might be influenced by another factor.

**Next steps...**

Increase the replicate size to provide more reliable statistical results.

Find sites which differ in soil structure and examine the effects of soil development on the bioavailability of PHEs.


References

1. European Commission (2006) Soil Thematic Strategy, COM(2006) 231.
2. Ross, S.M. (1994) Toxic metals in soil plant systems. Chichester u.a: Wiley.
3. Image: Zulfanmuhammad, women, shorturl.at/demRS


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