



**JICA SATREPS RESARCH  
PROJECT**



# **Kabwe Mine Pollution Amelioration Initiative Project**

## **Group 3**

**School of Mine, the University of Zambia  
Faculty of Engineering, Hokkaido University**

# Group 3 Activities

- Characterization of mine wastes and groundwater in Kabwe
- Sampling and characterizing dust in Kabwe
- In situ pilot-scale embankment experiments in UNZA
- Monitoring the mobility of heavy metals, such as Pb, Cu, and Zn, and evaluation of the effectiveness of countermeasures against immobilizing heavy metals
- Capacity building of remediation and related technologies

# Characterization of mine wastes

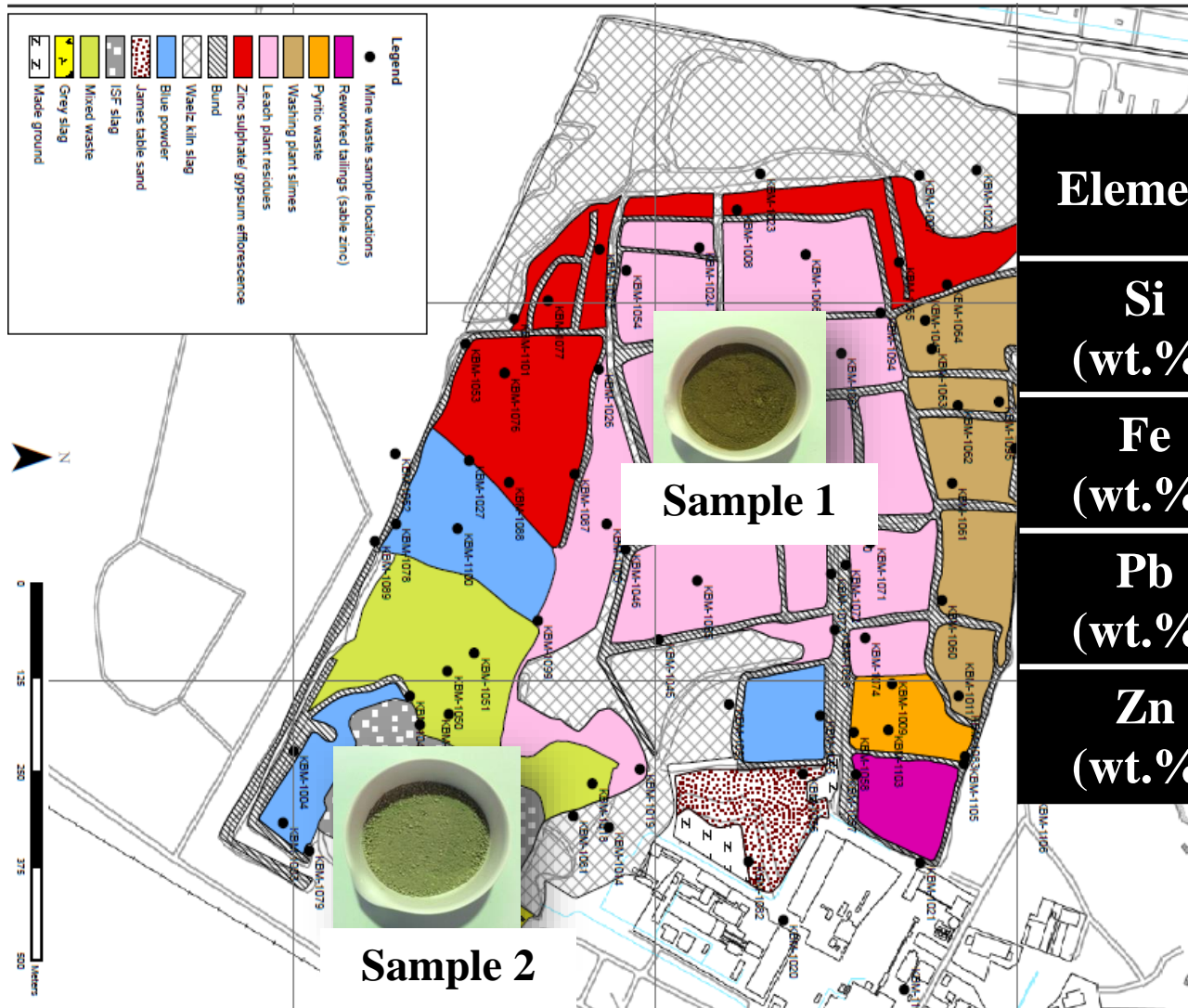
- Chemical compositions
- Mineralogical compositions
- Leaching experiments



Adsorption (or immobilization) tests

$\text{FeSO}_4$ , **dolomite**, zero-valent Fe, and zeolite were selected.

# Sampling locations of soil samples



## Results of XRF

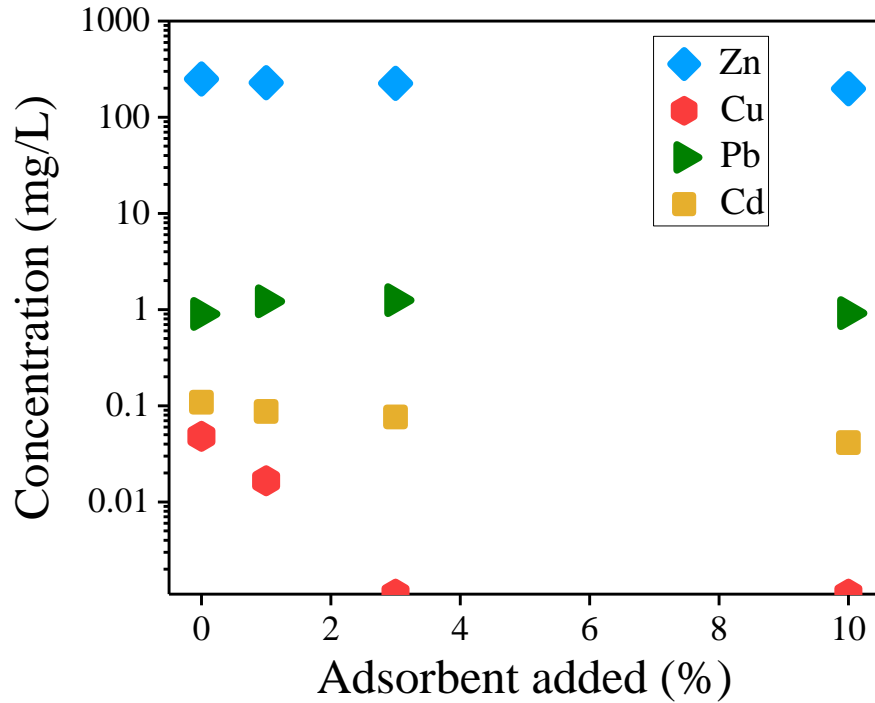
Element	Sample 1	Sample 2
Si (wt.%)	20.9	45.8
Fe (wt.%)	45.8	3.3
Pb (wt.%)	10.9	40
Zn (wt.%)	8.1	23.1

**Samples 1 and 2 contain higher Pb and Zn.**

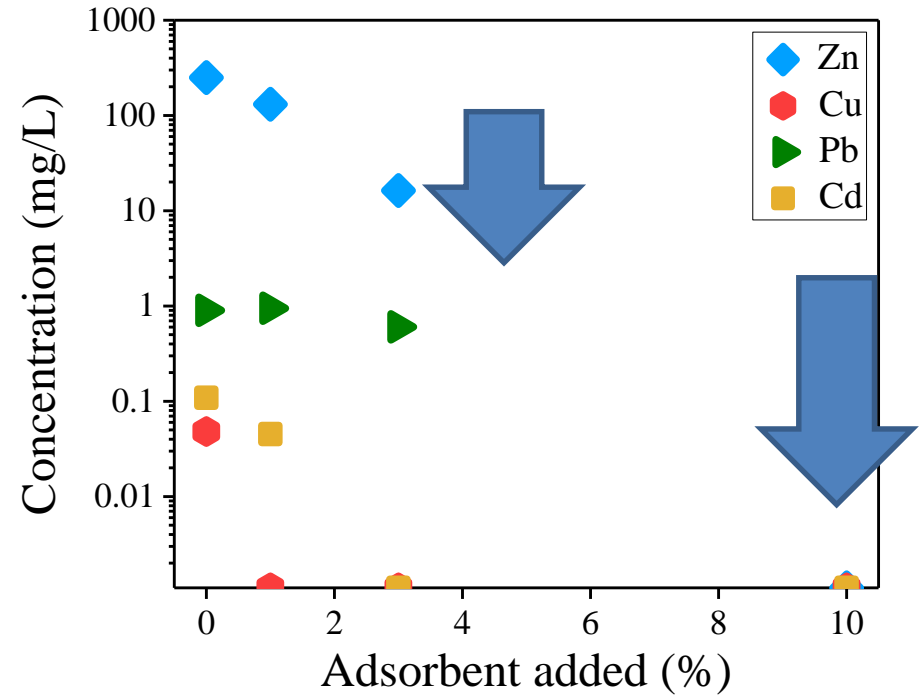
There are a variety of tailings in Kabwe. However, two samples were selected for immobilization tests.

# Adsorption of Zn in Zn leaching residues

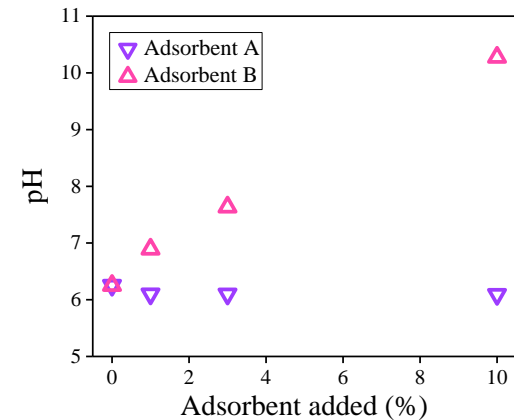
## Adsorbent A ( $\text{FeSO}_4$ )



## Adsorbent B (dolomite)



- ✓ Adsorbent A is effective in reducing the concentration of Cu.
- ✓ Adsorbent B is effective in reducing the concentrations of heavy metals.



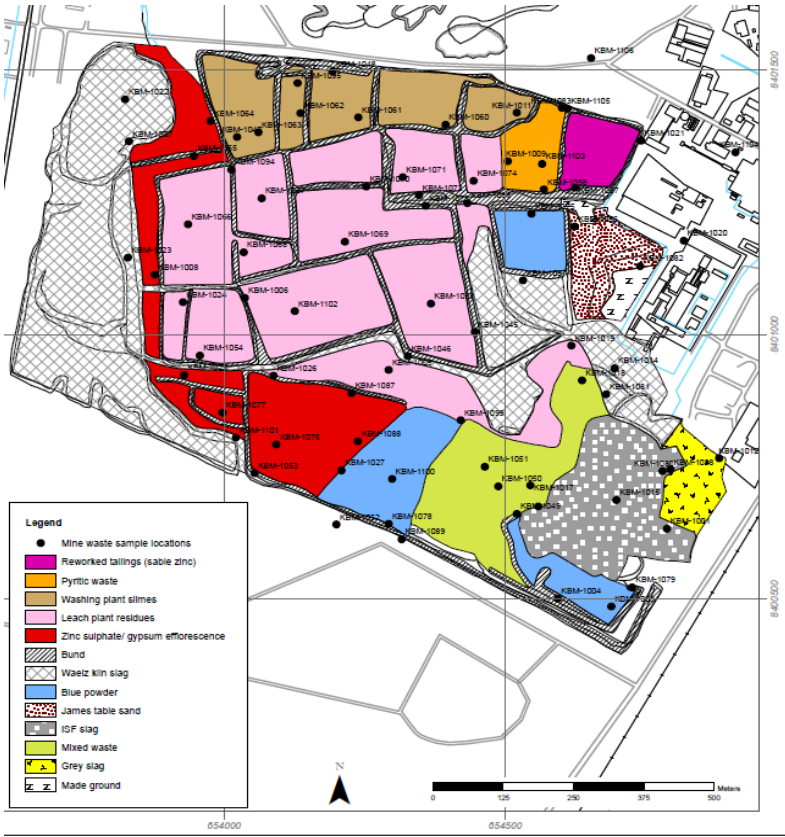
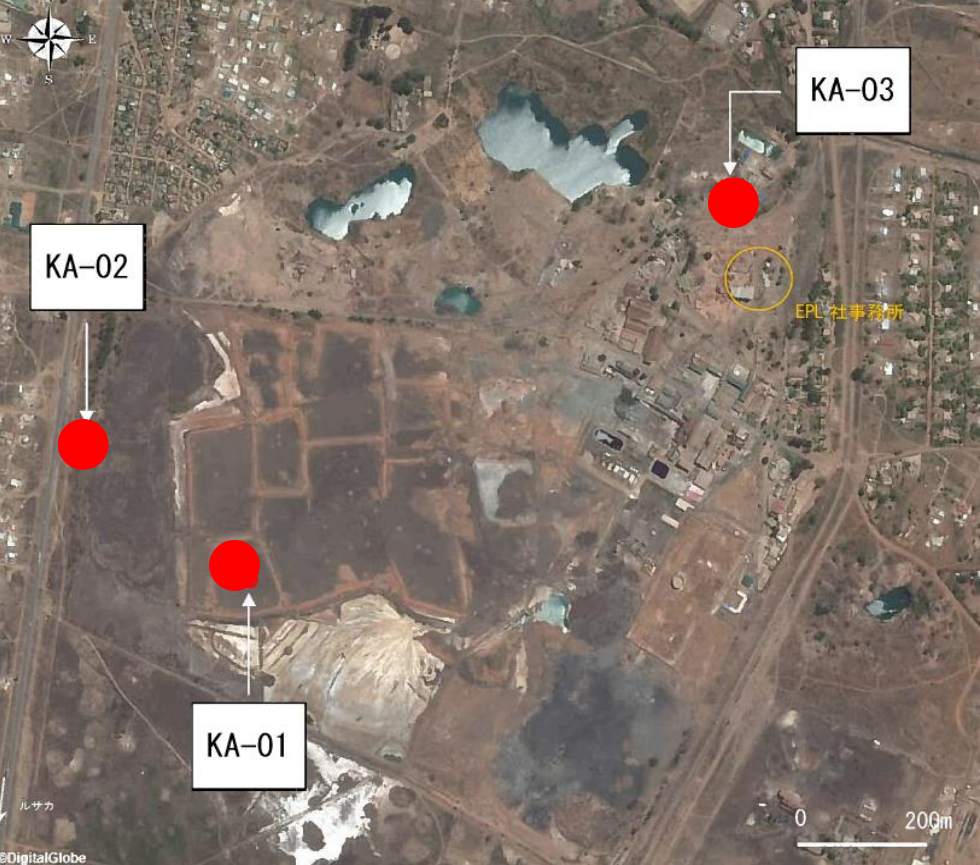
# Characterization of geochemical condition in Kabwe

- Excavation of three boreholes (10 - 15 m deep)
- Continuous monitoring of the groundwater levels
- Periodic sampling for groundwater chemistry
- Dust sampling and chemical analysis



Adsorption (or immobilization) tests

# Location of boreholes in Kabwe





Borehole in Kabwe



Groundwater sampling by pumping



Groundwater sampling by bailer



In situ pH, EC, and ORP measurements



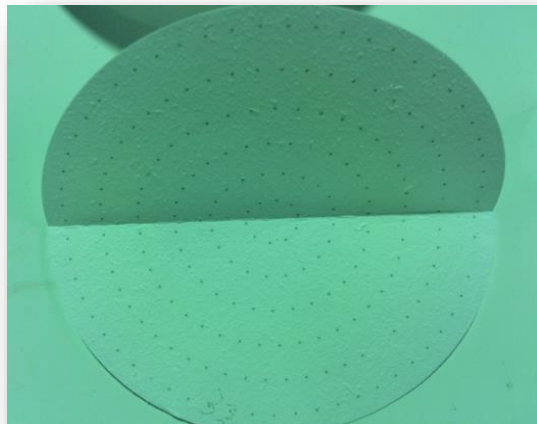
# Dust sampling



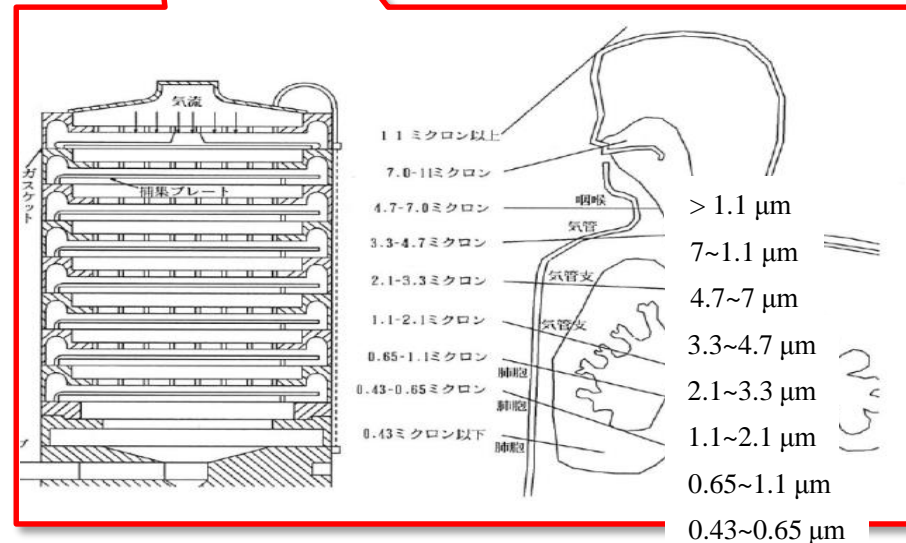
Sampling points



Sampling



Collected dust on the filter



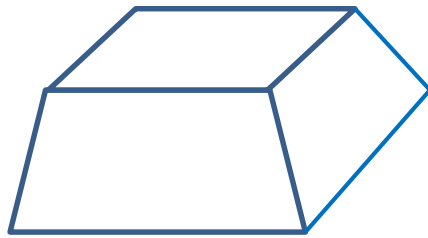
# Pilot scale test site in UNZA



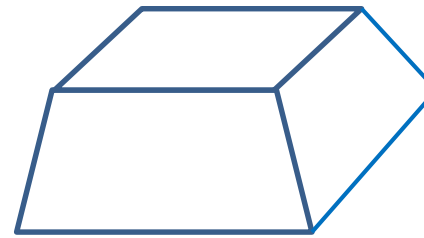
©Storage place of Soil in UNZA(15° 39'7.85"S28° 33'6.77"N)

# Pilot scale tests

- ❖ We selected **calcinated dolomite** for pilot scale tests.
- ❖ We construct **4** embankments using **Zn leaching residues**.

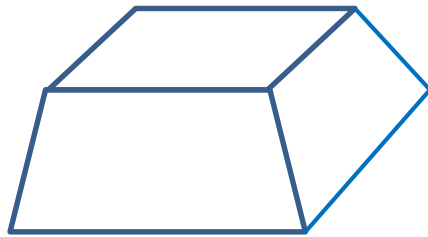


Case 1 : Covering soil

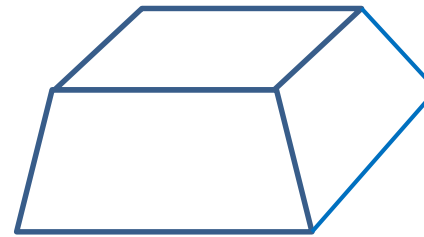


2 m  
Case 2 : Dolomite

1 m



Case 3 : Dolomite + covering soil



Case 4 : Covering soil + plant



Location setting of pilot tests



Excavation of surface soil for pilot tests



Excavation of pit for effluent (1)



Excavation of pit for effluent (2)



Excavation of Tailings from Kabwe



Transported by a dump truck



Tailings transported from Kabwe



An impermeable sheet is used for storage

# Dolomite sampling (2017 July)



United quarries Ltd.,  
Oriental Quarries Ltd.,  
and others



XRD, XRF, and  
Adsorption tests



Selection of high-  
quality dolomite

# Calcination of dolomite (2017 September)



Original dolomite from Oriental Quarries



Furnace of NISIR



Measurements of bulk density before and after calcination



Roller mill for crushing calcinated dolomite of NISIR



Portable heavy metal analysis method



Sampling of heavy metal-bearing solution



Groundwater sampling using a bailer



Colorimetry