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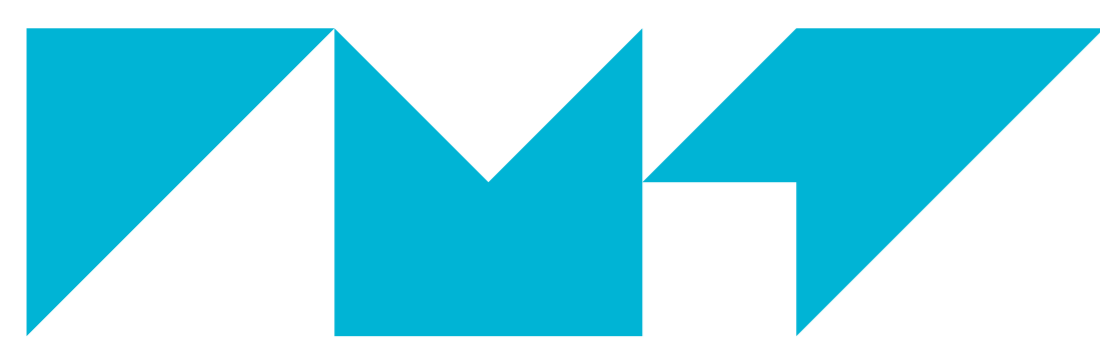
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# Identification of atmospheric dust sources around a smelting site within the Congolese Copperbelt

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## 1 CONTEXT



Open pit mine within the Congolese Copperbelt

Mining activities are expected to increase in the DR Congo due to the growing demand for cobalt and copper, that are strategic metals for the energy transition (Crundwell et al., 2020).

Previous toxicological studies conducted in the Congolese Copperbelt have shown high health impacts (pulmonary and cardiovascular) associated with airborne particulate matter (PM) emitted by mining activities (Cheyns et al., 2014). Yet, physico-chemical properties of these PM are not well characterized.

## 2 GOAL OF THIS STUDY

To identify the possible sources of atmospheric dust around a smelter in DR Congo and their respective chemical tracers using **Principal Component Analysis (PCA)** and **Cluster analysis**.

## 3 METHODOLOGY

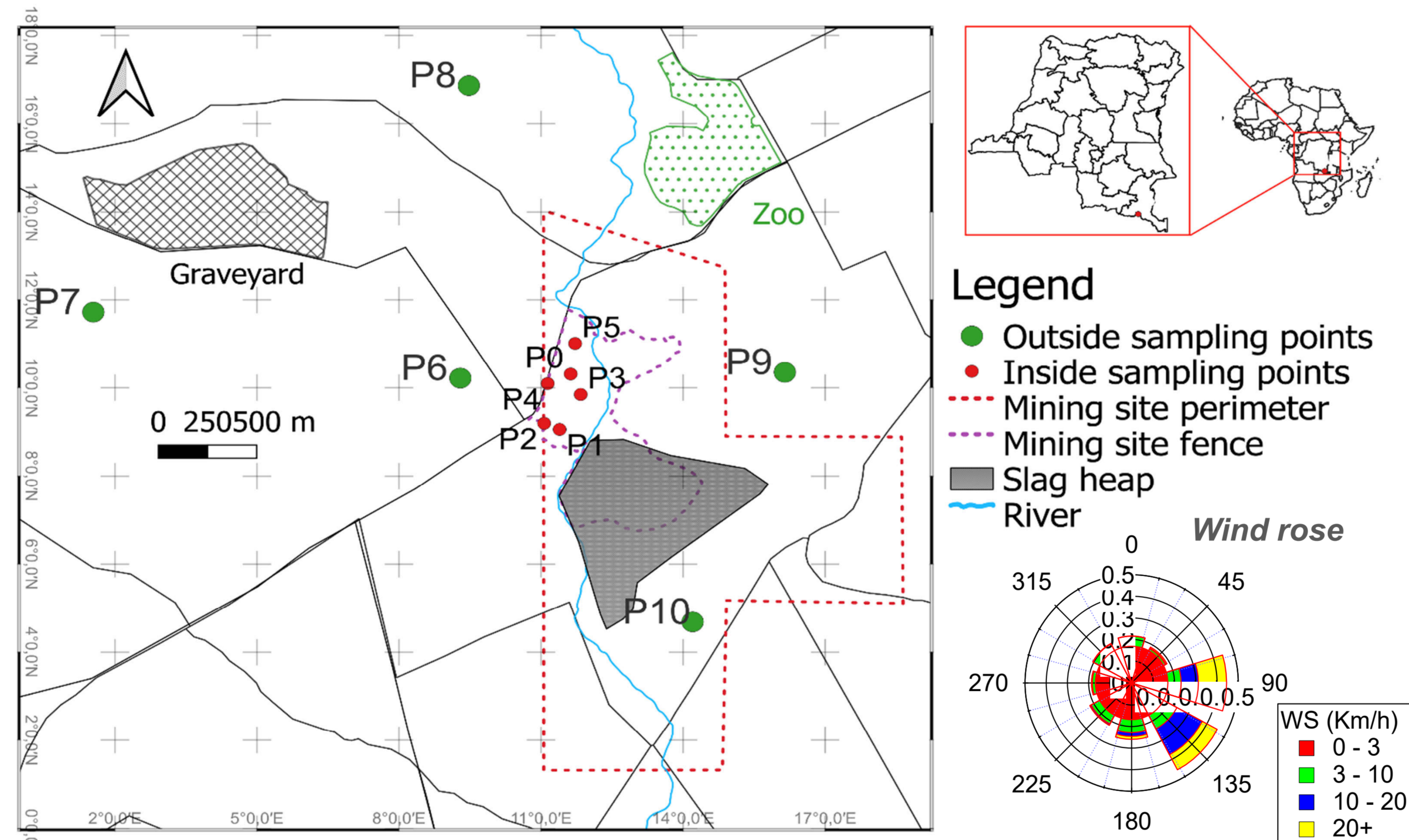
- PM sampling at 10 locations both **inside** and **outside** of the mining site (3 replicates) using a **Dekati 3-stage cascade impactor** (30 L min<sup>-1</sup>, 4 size fractions: >10 μm, 2.5-10 μm, 1-2.5 μm and <1 μm) on Teflon filters
- Monitoring of local meteorological data (from July to August 2022)
- Chemical analysis (ICP-MS/ICP-AES) and source identification (PCA - Varimax rotation)



PM sampling on the smelting site

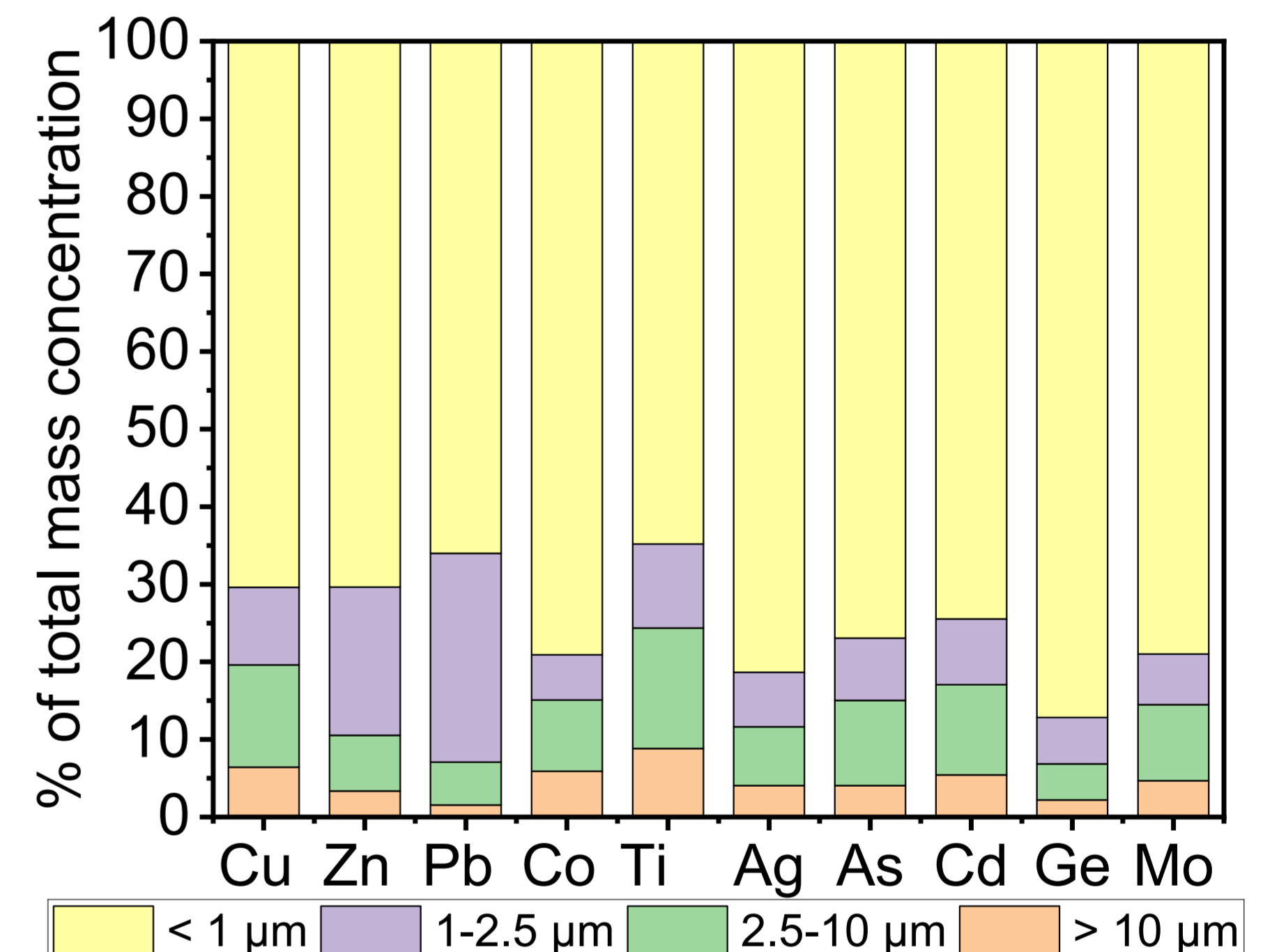
## 4 SAMPLING SITE

The smelter located in Lubumbashi city, produces white **alloy (Co-Cu)** and **ZnO powder** at 1450 °C by carbothermic reduction from an old slag heap (**Co-Cu-Zn-(Ge)**).



## 5 RESULTS AND DISCUSSION

**Gravimetric** results showed that PM<sub>1</sub> are the most abundant with mean value (P1-P10) of 125-420 μg m<sup>-3</sup>.



Metals related to the slag composition and industrial process are predominant: **Pb** (1-55 μg m<sup>-3</sup>) and **Zn** (14-152 μg m<sup>-3</sup>) in PM<sub>1-2.5</sub>, **Ge** (0.01-0.35 μg m<sup>-3</sup>) in PM<sub>1</sub>

## Acknowledgements

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## References

- Cheyns et al., (2014) *Science of The Total Environment* 490, 313–321
- Crundwell et al., (2020) *Minerals Engineering* 156, 106450.

According to our knowledge of the industrial process:

**Fine fraction: 5 PCA factors** explain 79% of the total PM<sub>2.5</sub> data variance

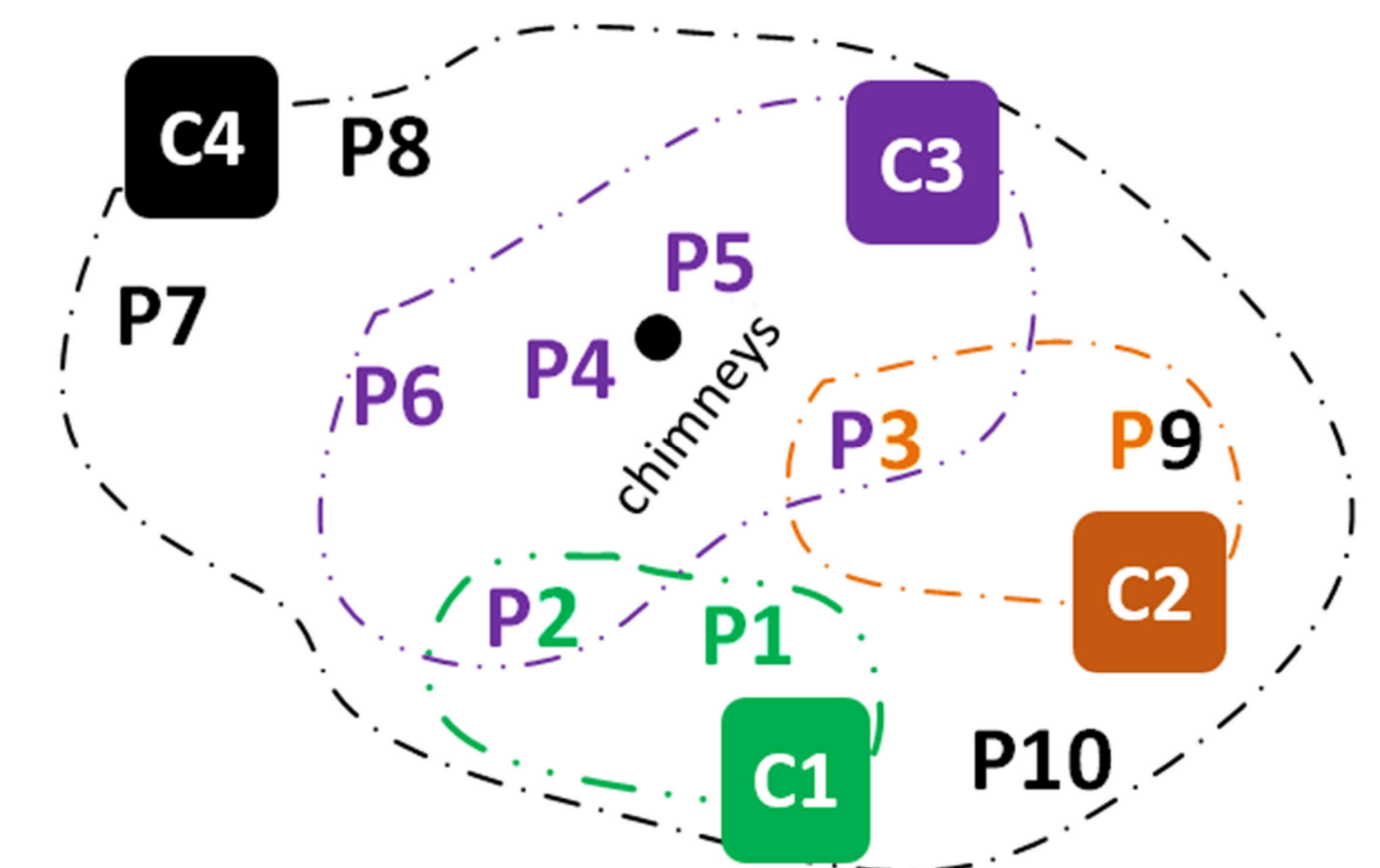
- **F1** (31%): As, Cd, Co, Cu, U ⇒ stack gas and smoke
- **F2** (22%): Co, Ge, Mo ⇒ metal granulation (Co-Cu)
- **F3** (12%): Ca, Fe, Mn, Ti, Al ⇒ unenriched slag and raw materials
- **F4** (7%): Cr, Ni ⇒ likely PM from Cr furnace refractories and wear of mechanical parts
- **F5** (7%): Pb, Zn ⇒ fugitive dust from ZnO powder circuit

**Coarse fraction: 5 PCA factors** explain 89% of the total coarse PM (>2.5 μm) data variance, with **2 main PCA factors**

- **F1** (39%): As, Cd, Co, Cu, U ⇒ dust resuspension from old contaminated soils
- **F2** (20%): Al, Ba, Ti ⇒ crustal sources

**Cluster analysis** (Ward's method, Squared Euclidean) resolved 4 clusters (C1-C4) with comparable characteristics for PM sampling points.

We hypothesize that **C3 (Zn, Pb and Ge)** is a deposition zone of particles from the chimneys. **C4 (Ti)** refers to background. To be confirmed with future analysis of **deposits** and **top soils**.



## 6 PERSPECTIVES

Further research may focus on identifying transport pathways of metals and metalloids from the atmosphere to soils.