



2023 Master internship at UCA



TITLE: Potential risk of exposure to metal pollutants present in dust from different environments (industrial, mining, port...)

LAB & PEOPLE

- Name of the hosting lab: Environmental analytical chemistry (4.4.4.016_Faculty of Sciences, University of Cadiz)
- General activities of the lab:
 - Innovation in preconcentration, separation and analysis methodologies for trace elements.
 - Design of sensing molecules and optical sensors for metal determination.
 - Assessment of the metal pollution in different environmental ecosystems and its impact: speciation, bioavailability, bioaccumulation, bioaccessibility, ecotoxicological effects and bioindicators of metal contamination.
 - Use of non-living biomass from plant and food waste as metal sorbents
 - Chemometric techniques in the development of analysis methodologies and their application in Analytical Chemistry.
- Website:
<https://rnm236.uca.es/>
<https://produccioncientifica.uca.es/grupos/7849/detalle/>
- Number of staff / PhD: 6/4
- Supervisor name and contact:
Prof. Dr. M^a Dolores Galindo Riaño
Department of Analytical Chemistry, Faculty of Sciences, University of Cadiz, Puerto Real, Spain, 11510. E-mail : dolores.galindo@uca.es

TOPIC OF THE INTERNSHIP

- Scientific context of the internship (max 20 lines)

The impact of air quality on human health is highly considerable according to the World Health Organization (WHO), therefore the control and reduction of air pollution are contemplated in the sustainability objectives of the 2030 Agenda. Particulate matter can be found among the components of the air from different origin both natural and anthropogenic, which can be transported and remain in airborne or deposited and accumulated as dust on surfaces of different environments affecting humans.

The presence of heavy metals (HM) in dust represents a significant exposure pathway for humans. Since HM can be bioaccumulated, not biodegraded and persistent in the environment for a very long time, it is of great interest to assess the potential effects they can produce on human and environmental health if they are present in dust.

The aim of this research focuses on the evaluation of the potential risk of exposure to metallic contaminants present in the dust deposited in different areas of southern Spain with significant influences from anthropic activities and potential sources of dust with HM contents. Elements of interest according to the European Air Quality Directive (Pb, Ni, As, Cd) as well as those that are significant in the dust according to its origin (metallurgy, fossil combustion, road traffic...) will be studied. The methodology includes the sampling and characterisation of the dust particles (size, mineralogy and morphology), as well as the evaluation of the total content of HM, the geochemical bioavailability and the bioaccessibility in humans. Based on the results, environmental quality indices and exposure risk assessment models will be applied, which will allow to define the potential risk to health of the dust sampled in the studying areas.

Keywords: metal, air pollution, dust, health risk, bioavailability, bioaccessibility

Bibliography:

- Bartholomew, C. J., Li, N., Li, Y., Dai, W., Nibagwire, D., Guo, T. (2020). Characteristics and health risk assessment of heavy metals in street dust for children in Jinhua, China. *Environmental Science and Pollution Research* 27(5), 5042-5055. (2020) 27:5042–5055. <https://doi.org/10.1007/s11356-019-07144-0>
- Behrooz, R.D., Kaskaoutis, D.G., Grivas G., Mihalopoulos, N. (2021). Human health risk assessment for toxic elements in the extreme ambient dust conditions observed in Sistan, Iran. *Chemosphere* 262, 127835. <https://doi.org/10.1016/j.chemosphere.2020.127835>
- Consolidated text of Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe (2015). Document 02008L0050, p. 1-56.
- Faten Khelifi, F., Caporale, A.G., Hamed, Y., Adamo, P. (2022). Bioaccessibility of potentially toxic metals in soil, sediments and tailings from a north Africa phosphate-mining area: Insight into human health risk assessment. *Journal of Environmental Management* 279, 111634. <https://doi.org/10.1016/j.jenvman.2020.111634>
- Huang, R., Yuan, W., Wang, T., Cao, W., Wang, Y., Lin, C., Yang, L., Guo, J., Ni, H., Wu, F. (2022). Chemical signature and fractionation of trace elements in fine particles from anthropogenic and natural sources. *Journal of Environmental Sciences* 114, 365–375. <https://doi.org/10.1016/j.jes.2021.09.015>

- Tasks and duties entrusted to the student:

The student will collaborate in:

1. Sampling of dust in different areas of southern Spain.
2. Fractionation of the samples by particle sizes to obtain the more hazardous particles
3. Characterization of dust samples: mineralogy and morphology by DRX, FRX, DLS, SEM/TEM...

4. Pretreatment of dust sample to different studies (acid digestion, sequential extraction,...)
5. Chemical characterisation of dust samples: organic matter, total metal content and speciation of metals by sequential extraction (geochemical bioavailability)
6. Use of atomic techniques (Flame-AAS (atomic absorption spectroscopy), ICP-OES (inductively coupled plasma coupled to optical emission spectrometry), ICP-MS to metal analysis
7. Validation of the applied analytical methods
8. Study of the metal bioaccessibility by human exposure to dust samples.
9. Classification of dust samples based on environmental quality indices and health risk models and their correlation with possible sources of contamination by metals.
10. Tasks related to the application of statistical and chemometric techniques in chemical analysis.
11. Scientific search and writing.

- Skills to be acquired or developed:

1. Sampling design for environmental purposes.
2. Handling of common preparation, digestion, separation and preconcentration methods of samples for heavy metal analysis.
3. Knowledge of physicochemical characterisation of particles.
4. Management of speciation analysis and sequential extraction.
5. Use of certified reference materials (CRMs) for the validation of analytical methods.
6. Knowledge of methodology to evaluate the human bioaccessibility of pollutants.
7. Management of diverse instrumentation, mainly atomic spectroscopy (ICP-OES, ICP-MS, AAS) for metal analysis.
8. Application of data processing tools.
9. Ability to interpret and discuss the results obtained.

PROFILE OF THE DESIRED STUDENT

- Minimum level of study required: university graduate
- Field(s) of study: chemistry (analytical or environmental profile)
- Scientific skills: laboratory skills (handling of material and equipment, basic laboratory operations, etc.); scientific reading and writing; management of data processing software
- Language skills required: spoken and written English (medium or high level)

THE INTERNSHIP ASSIGNMENT:

Desired duration of the internship (in months): 3-6 months (it will determine the degree of skills to be acquired)

Desired Starting date of the mission: *(please indicate the level of flexibility)*: between 1st November 2023 – 31st July 2024

Indicative weekly schedule: 25 h / week

Remuneration: *Erasmus grant*

Internship agreement: *an internship agreement will be signed.*

To SEA-EU students:

If you're interested please send your CV and letter of motivation to the scientist in charge, to email:
dolores.galindo@uca.es , before 30 / 09/ 2023