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# *« Abandoned mines & trace metals contamination: trace metal transfer from mining waste deposits to the abiotic compartments of the critical zone »*


**Supervision & contacts**

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**Abstract**

The exploitation of mineral resources is one of the most disturbing forms of anthropogenic activity: (i) the drilling and excavation of shafts and galleries disturbs the circulation of underground waters, (ii) the excavation of sulphide minerals favours their alteration by surface waters (rain, run-off), and (iii) the ore smelting produces tailing and fumes. All these lead to trace metal (TM; e.g., Pb, Sn, As, Cd, and Cu) dispersal through airborne and waterborne pathways. It ends in contamination of waters, soils, and fluvial and lake sediments. Depending on the processes of TM transfer, their final speciation and spatial distribution, TM can be a significant source of pollution in the different compartments of an ecosystem.

In the northern French Alps, hundreds of orphan mines (>50 years and up to > 150 years since mine closure) are scattered, which waste dumps are still rich in TM and thus are a potential source of present-day TM contamination.

The aim of this PhD project is to characterize TM trajectories in the environment, from waste deposits (ore, slags) to the abiotic compartment of the ecosystem (soils, stream and lake sediments) in order to **provide better knowledge of the geochemical cycle of TM in an ecosystem affected by former mining activity**. The processes of TM transfer (airborne vs waterborne) and their persistence in a mountainous environment will be investigated at 3 different scales: (i) at the mine-scale (Peisey-Nancroix, Challanches, St-Georges d'Hurtières mines), (ii) at the watershed scale (Arve valley), and (iii) at regional scale (northern French Alps). This study will focus on a source-sink and diachronic approach, based on a multi-proxies study (ore, slags, soils, stream and lake sediments) and mineralogical (optical microscope, SEM, XRD, microprobe), geochemical (ICP-AES, ICP-MS) and geochronological ($^{14}C$) analyses.

The PhD candidate is expected to (i) map the TM contents in soils, stream sediments and in lake sediments, (ii) identify the mineral phases carrying the TM in the various abiotic compartment of the critical zone (ore, soils, stream and lake sediments), (iii) characterize the speciation and bioavailability of the TM in the various proxies, and (iv) determine the transfer processes to the abiotic compartments of the critical zone at the watershed scale.


**Application**

The student will have strong skills in mineralogy and geochemistry. Strong interest in environmental science, metal contamination and cross-disciplinary studies (e.g., biogeochemistry) will be considered. The student will have to master English, show editorial skills, and have a laboratory experience as well as fieldwork interest and skills. The supervisors and all the EDYTEM colleagues involved in the project will provide the student with their skills in mineralogy, sedimentology, pedology, geochemistry and metallogeny. The student will use EDYTEM analytical facilities, including sedimentology, elementary (XRF) and molecular (infrared spectroscopy) geochemistry, mineralogy (SEM imaging) as well as sediment dating (gamma spectroscopy)

The procedure for awarding doctoral grants is competitive (subject + candidate) within the SISEO doctoral school. As a result, candidates should have a very good academic record.

***Interested candidates can now send a CV, a cover letter and their Master's quotation to Magali Rossi.***