

36 month doctoral position in France Aix Marseille University

○ **JOB TITLE**

Plant biomimetics for rare earth extraction from secondary sources.

○ **JOB PROFILE/TYPE :**

Contract : temporary doctoral position (36 months) starting on september 2021

Employer : Aix-Marseille Université

Gross salary 1768 €/month

○ **KEYWORDS**

Rare earth, REE accumulating plants, metabolomic, lixiviation test, bauxite residu, mining residue

○ **JOB LOCATION**

Aix Marseille University (France): CEREGE (Site de l'Arbois, Aix en Provence), IMBE (St Jérôme, Marseille)

○ **ADVISORS**

Blanche Collin (Assistant professor AMU-CEREGE), Steven Criquet (Assistant professor AMU-IMBE, HDR), Clément Levard (researcher CNRS)

○ **PI of the project**

Blanche Collin (Assistant professor AMU-CEREGE)

○ **JOB DESCRIPTION**

This 36-months' doctoral fellow is funded by the new [Mediterranean Institute for Environmental Transition](#) (A*Midex), an interdisciplinary initiative aiming to tackle the challenges of the ongoing climate nexus, and will begin on october 2021

Description of the position:

With the development of advanced technologies (e.g. microelectronics, photovoltaics, electric mobility, etc.), the number of metals used by industry has exploded, rising from around fifteen in the early 1970s to over fifty today (Reuter and van Schaik 2012). These

metals, including 'critical' metals (EU report, 2020), have become crucial for most industrial sectors and are at the heart of economic, geopolitical, societal and environmental issues. This is the case for rare earths (REE), whose success lies in their magnetic, optical and electrical properties. The life cycle of these metals is therefore the subject of particular attention, especially their production. In a circular economy approach, one challenge is to find, in the near future, secondary sources of metals in order to face supply risks and reduce the pressure on primary resources. Many wastes produced in large quantities are potentially good candidates for recycling these critical metals, such as bauxite residues (residues from alumina extraction) or residues from phosphate processing (Binnemans et al. 2015). Moreover, current pyro- and hydrometallurgical extraction processes are not always suitable for the extraction of these critical metals and represent a high environmental cost.

In this context of increasing pressure on strategic metal resources, the project in which the thesis is held proposes to develop innovative extraction processes for critical metals, based on biological mechanisms, in order to develop a waste valorization of industrial and mining residues. Biology has always been a strong source of inspiration for developing processes with reduced environmental costs. Concerning REEs, the evidence of their use by living organisms is quite recent. The understanding of the mechanisms involved opens up promising new perspectives, particularly for the development of extraction processes for these metals.

The objective of this thesis is 1- to understand soil-plant transfer of REE and in particular to identify the biological molecules involved 2 - to test their potential for complexing REEs by selective leaching tests of mining or industrial residues. The plants used will be REE hyperaccumulating plants: *Dicranopteris dichotoma* and *Phytolacca americana* as well as new accumulating plants identified on mining sites rich in REE (France and Morocco). These plants will be grown on REE rich soils and substrates from modified bauxite residus. A metabolomics approach will be used to identify the metabolites exuded by the plant roots in response to the presence of REE. In a second step, the identified molecules will be used for selective leaching tests of REEs in 3 industrial and mining residues from the Mediterranean basin: bauxite residues stored in Bouc-Bel-Air and two mining residues from coal extraction and phosphate treatment in Morocco.

○ **QUALIFICATIONS/SKILLS/EDUCATION & RESEARCH REQUIREMENTS/DUTIES**

The doctorate will be hired for *36 months* with the following preferred skills:

- Master's or equivalent degree in plant environmental science or agronomy, biogeochemistry
- A desire to be part of an interdisciplinary project in environmental sciences at the interface between biology, ecology, chemistry and pedology.
- Affinity for biophysical-chemical analytical techniques and experimental sciences
- Interest in the phytoextraction of trace elements and the study of the functioning of the rhizosphere

- Rigor / organization
 - Good communication skills
 - Oral and written English proficiency.
- **APPLICATION DEADLINE**
Applications must be submitted by July 6, 2021. For selected candidates, interviews will be held July 12, 2021.
- **REQUESTED DOCUMENTS OF APPLICATION AND CONTACT TO APPLY**

A motivation letter, a CV, letters of recommendation (2 at least), available M1 and M2 grades (with mention and ranking in the student group; note that at least an AB mention in M2 is required) and a previous internship pdf report (e.g. the one from the last master's degree) should be sent to B. Collin (collin@cerege.fr)

For more information, candidates are also invited to contact Steven Crique (steven.crique@imbe.fr) et Clément Levard (levar@cerege.fr)