

Host institution

SCK CEN is a global leader in the field of nuclear research, services and education. SCK CEN is located in Belgium with around 800 employees and 80 PhD students from 40 different nationalities. As a Foundation of Public Utility (FPU), the Belgian Nuclear Research Centre has the assignment to maintain a centre of excellence on nuclear energy and ionizing radiations. Next to specialised RD&D in the field of a.o. radioactive waste management and disposal, radiobiology and -ecology, research is also performed in human space exploration, social sciences, hydrogeology, (micro)biology and environmental chemistry. SCK CEN is equally involved in research projects investigating the impact of Naturally Occurring Radioactive Materials (NORM) in the context of geothermal energy production and legacy waste contamination. Within the Environmental Health and Safety Institute (EHS), the Waste & Disposal (W&D) Expert Group disposes of numerous state of the art research laboratories and facilities (including inert gas atmosphere glove boxes, analytical equipment, dedicated setups, etc.). Moreover, the Group has developed and used numerous modelling tools such as the environmental reactive transport code HPx (coupling of Hydrus and PhreeqC), COMSOL, etc. up to complete safety and performance evaluation assessments of waste disposal facilities. Throughout its more than 60 years of research experience, SCK CEN has also conducted numerous Education and training (E&T) activities coordinated by its own Academy, which offers different scientific courses, but mainly focusses on giving students the possibility to perform their PhD studies in a unique environment of innovative facilities and technologies in collaboration with different national and international universities.

Research objectives

The PhD project proposed by SCK CEN within the frame of the PANORAMA project aims at studying the speciation and transport of Rare Earth Elements (REE) in Passive Treatment Systems (PTS) of the Iberian Pyrite Belt. The main objective is to investigate the efficiency of components used in the PTS and more specifically in the reducing and alkalinity producing systems (RAPS= limestone and organic matter) and to determine the immobilization relevant chemical reactions. Column experiments will be used to mimic PT systems under conditions representative for the field site. It is foreseen to perform different types of well constrained column experiments enabling to control at the same time chemical parameters (pH, REE concentration, trace metals...), as well as hydrological parameters, such as the flow rate and residence time. Batch-type experiments will also be performed to study which mechanisms are involved in the mitigation of REE concentrations in the AMD PTS, such as e.g. sorption, (co-)precipitation, and/or secondary phase formation.

Presentation of the research project (cooperative aspect)

This PhD position is within the framework of a European ITN project named PANORAMA: EuroPean trAining NetwOrk on Rare eArth elements environMental trAnsfer: from rock to human involving 15 PhD positions.

Under the supervision of SCK CEN and in collaboration with the University of Leuven (KU Leuven), the PhD student will:

- (1) Collect and analyze acid mine drainage water samples from selected sites of the IPB,
- (2) Use the collected waters in column- and batch-type experiments with selected components of the selected PTS to identify the main processes responsible for the immobilization of the comprised REE (i.e. sorption, (co-)precipitation, incorporation....) by paying particular attention to the role of kinetics,
- (3) Characterize formed secondary phases by different techniques, and
- (4) Model the experimental results using geochemical and colloidal/reactive transport codes.

The project involves a strong collaboration with (1) the University of Huelva (UHU) for the field work and sampling (2 months) including required research stays (secondments) for 2.5 months at (2) the French national synchrotron facility SOLEIL for the detailed characterization of the formed precipitates/secondary phases, and 2 months at (3) the Spanish consulting company AMPHOS21 to

perform geochemical and colloidal/reactive transport modeling supporting the interpretation of the experimental results.

The PhD student will be also involved in scientific/soft-skills meetings and in research activities conducted in other laboratories/companies from Europe and associated countries.

An important component of the training will be the participation to 3 main major **training events**:

WS1-(December 2020) REE as emerging contaminants: Properties, uses and dissemination – Germany-fundamental REE biogeochemistry and currently known anthropogenic REE inputs into the environment

SS1 (May 2021) - AMD and REE contamination mitigation - Portugal-Management and remediation solutions of AMD in old mining areas and Management of WEEE, recycling areas

WS2 - Colloids and nanoparticles as REE vectors -France- Structural characterization of colloids and nanoparticles by innovative and fine spectroscopic and scattering techniques: X-Ray absorption fluorescence and scattering, light scattering. REE interactions with bearing phases.

SS2 - (Eco)toxicology of REE –Germany- Eco)toxicological concepts and approaches, Physico-chemical properties of REE for bioavailability, ecotoxicity and environmental risk

In addition to these major milestones of the program, the PhD students will 1) continuously develop their **core research skills via their own research project** locally and within the network while at secondments and conferences, 2) receive a mandatory amount of **hard and soft-skills training** specific to their own doctoral school, along with mentoring by joint supervising bodies, 3) use **conferences both as dissemination events for ESRs results and network events for progress reports and evaluations**, and 4) **collaborate into practical activities aimed at network-structuring legacy deliverables**.

PANORAMA's research objective is to elucidate the man-induced environmental dissemination of REE and the associated effects on the environmental health. For that purpose, interdisciplinary approaches are required combining geochemistry, ecotoxicology, hydrology, chemical analysis and coupling field monitoring, original in and ex situ experimental set-up and modelling from the element speciation to the environmental impact

PANORAMA's key aim is to **set-up an optimal scientific and non-scientific training to the understanding and forecasting of the environmental impacts of new emerging pollutants such as REE**.

Benefits

With indicative financial conditions of the research project (in local currency)

- 3-years full-time employment contract
- Attractive salary tuned to living standards of the hosting country and according to the SCK CEN baremas (including mobility allowance).
- Based at SCK CEN with registration in the doctoral school of Leuven University.
- Possibility to collaborate with a large network of international research groups engaged in the ITN.

Requirements

- The candidate should be in the first four years of their research career. They should not have a doctoral degree and fulfil the eligibility criteria and mobility rule (see below).
- The candidate should hold or be about to obtain a Master's degree in Earth Science or relevant field.

The following expertise is regarded as a plus:

- Experience in aqueous geochemistry and laboratory work
- Skills in secondary phase formation techniques, such as XRD, XRF, SEM, ...
- Previous experience working with geochemical and/or reactive transport codes (e.g. Geochemist's Workbench, PHREEQC, COMSOL,...

- The ability to work both as part of a team, and independently, coupled with excellent communication, organizational and problem-solving skills,
- Availability to travel for training events and research secondments,
- Good ability to communicate in English (spoken/written),
- Excluded to apply are students from countries that did not sign the Non Proliferation Treaty (NPT).

ELIGIBILITY CRITERIA

Recruiting is in accordance with the European rules for Marie Curie Initial Training Networks. Early-stage researchers (ESR) can be of any nationality. They must be, at the time of recruitment by the host organization, in the first four years (full-time equivalent) of their research careers and have not yet been awarded a doctoral degree. The research career starts after the degree that enables a student to proceed with a PhD (usually, the Master degree).

MOBILITY RULE

At the time of the recruitment by the first host institution, the ESRs must not have resided or carried out their main activity (work, studies, etc.) in the country of their first host institution for more than 12 months in the 3 years immediately before the recruitment date. Short stays such as holidays and/or compulsory national service are not taken into account.

How to apply

Send your complete application to both contacts given below (application will remain open until position is filled).

A **single pdf file** needs to be submitted including:

- a cover letter, stating your research motivation and interests; including relevant background and career plan (max 1 A4 page)
- a Curriculum Vitae, including academic background, previous research and/or industrial experience (max 2 A4 pages)
- Degree transcripts (with marks)
- English language qualification certificates (or equivalent)

Reference letters:

- at least 2 confidential reference letters from academics (including name, position and email address of the referee) (max 1 A4 page, with substantiated assessment of the applicant's technical skills, creativity, innovation ability, working capacity, efficiency and level of independence) must be sent directly to the contacts below.

Additionally, **candidates should also apply for the PhD via the SCK•CEN Academy website** (by using the application button below the topic description). More details can be found under following link: <https://www.sckcen.be/en/phd-theses>

In case of questions you may contact the SCK CEN Academy by email (academy@sckcen.be), the ESR supervisor and/ or co-mentor (see contacts below).