Call for proposals: MSCA Postdoctoral Fellowship (H/F)
Function level: Post-doc R1
Département: GeM – GEOMEC

Willing to experience intersectoral, interdisciplinary and/or international research? Apply with Centrale Nantes to the MSCA Postdoctoral fellowship 2025 call for proposals and join us!

Candidate profile

We are seeking a highly motivated Postdoctoral Researcher with a background in experimental mechanics. In particular skills on testing materials of civil engineering via triaxial, oedometric and simple-shear apparati are recommended.

Basics of Digital Image Correlation techniques and competences in post-treatement of large data bases via Matlab or Python applications would be highly appreaciated.

Project description

Supervisor: Giulio SCIARRA

Keywords: Experimental geomechanics, clayey geomaterials, two-phasic flow, digital image correlation, localised strains.

Topic open: According to the IPCC AR6 synthesis report: Climate Change 2023, in global modeled pathways that limit global warming to 2 °C or below, almost all electricity is supplied from zero or low-carbon sources in 2050, such as renewables or fossil fuels with CO_2 capture and storage (CCS). CCS in deep geological formations has consequently emerged as an important option to reduce greenhouse gas emissions and CCS facilities are continuing to grow in Europe. However, global rates of CCS deployment are far below those envisaged to limit global warming. Enabling conditions such as policy instruments, greater public support but also scientific bottleneck release and technological innovation could reduce these barriers. It is the aim of the present project to work on these actions, in particular to increase knowledge in the interaction between the CO_2 injected in the geological storage site and the surrounding rocks, which should act as sealing barrier against CO_2 migration and leakage and guarantee long time storage security.

In particular the objective of the project is to develop a laboratory scale experimental campaign aiming at understanding the behavior of fine-grained geomaterials, which constitute the geological "tight" caprock that should guarantee the sealing of the CO2 storage reservoir against leakage. Similarity laws will be established in order to relate the real conditions with those of the laboratory experiment, and therefore reconstruct in a physical model, limit hydromechanical loadings corresponding to hererogeneous fluid percolation through the caprock (fingering), induced localized strains and fracturing. According with established similarity rules the role of confining stress will be deeply investigated in order to understand its role in fracture triggering induced by fingering.

Tests will be developed on a centimeter-sized sample (50 x 40 x 11 mm^3), inside an original biaxial testing device, BIAX (https://gem.ec-nantes.fr/acadp_listings/machine-dessais-biaxiaux/) available at GeM since 2020, which allows spatial and temporal monitoring of deformations and two-phase flow (e.g. water and gas) through a porous medium. BIAX is in fact a Bishop-Wesley type device characterized by two pairs of transparent windows, one in contact with the two surfaces of the sample and the other which constitutes the external walls of the confining chamber. These windows allow direct visualization of the surface of the sample so that spatial and time propagation of the gas injected into the initially water saturated porous space can be monitored together with the induced displacements. This monitoring is obtained through an optical system consisting of two 50 Mpx cameras each, mounted with telecentric lenses on both sides of the device. For a centimeter-sized sample like the one previously mentioned, the spatial resolution of the optical system is 6.1 µm/pixel. In parallel with macroscopic measurements, such as the variation in the volume of the sample due to the redistribution of the gas inside the deformed sample, together with a punctual measurement of the porewater pressure within the sample, Digital Image Correlation (DIC) methods will be used to measure the displacement field, and therefore the deformation, on the surface of the sample in contact with the confining wall. UFreckles DIC software, developed at GeM, will allow the monitoring of flows and deformations from a sequence of images properly processed in order to reinforce the contrast between the areas invaded by the gas and those still saturated with water. The system, used in recent years for monitoring flows and deformations in

sandy materials (Fontainebleau sand), will be adapted to the study of the behavior of clayey geomaterials, which will require adapted sample preparation, adjustment of the optical system and of the image correlation techniques. A campaign of experimental tests on samples of clayey materials reconstituted in the laboratory will be set up to reproduce the effects of CO_2 pressurization controlling the confinement constraints acting on the sample. Image recording throughout the process will allow monitoring of gas percolation and the deformation of the solid skeleton that results from it.

Call information

Organisation	Ecole Centrale Nantes
Research field(s)	Environmental Geomechanics
Researcher Profile	R1 – First stage researcher
Country	France
Application deadline	31 March 2025
Type of contract	Temporary
Job status	Full-time
Hours per week	39
Offer starting date (estimated)	1 Apr 2026
Is the job funded through the EU Research Framework Programme?	Horizon Europe – MSCA European Postdoctoral Fellowship

Research environment

Centrale Nantes is a top-ranked institution recognized internationally for its excellence in research and education, particularly in engineering and technology. It is known for its leadership in fields such as **marine engineering**, **civil engineering**, and **mechanical engineering**, frequently appearing in the upper echelons of global rankings. For example, it ranks **125th worldwide in Mechanical Engineering** according to the **QS World University Rankings by Subject 2024**, reflecting its prominence in this area.

Additionally, Centrale Nantes is positioned in the **top 300 globally for Engineering,** and in the **top 500 for Physical and Computer Sciences** in the **Times Higher Education World University Rankings by Subject 2024**, highlighting its multidisciplinary strength.

Notably, Centrale Nantes was named **the top institution in France in the "Engineering Schools to Change the World"** ranking, compiled by **Les Echos START and ChangeNOW**, which evaluates schools based on their contributions to social and ecological transitions. This ranking showcases its dedication to sustainability and innovative solutions to global challenges.

Centrale Nantes' research extends beyond traditional engineering disciplines. It is recognized for pioneering work in **artificial intelligence** and **robotics**, often ranking among the **top 100 worldwide** in these fields. Its **computational mechanics** and **hydrodynamics** research centers are considered among the best in Europe, further cementing its status as a leader in cutting-edge scientific research.

Through strong global partnerships and innovative initiatives, Centrale Nantes continues to enhance its reputation as a world-class institution in scientific and technological research, with a strong focus on sustainability and impactful solutions for societal challenges.

Please take look at our institution before submitting your application: https://www.ec-nantes.fr/

Profile required

Eligibility criteria - Specific Requirements

- **You are a First-stage or an Experienced Researcher** eg. in possession of a doctoral degree at the time of the call deadline (10th Sept 2025) and a maximum of 8 years full-time equivalent experience in research (self-assessment tool here).
- **You comply with the mobility rule**: eg. you must not have resided or carried out your main activity (work, studies, etc.) in France for more than 12 months in the 36 months immediately before the call deadline (September 10th, 2025). All nationalities welcome!
- **You want to carry out an innovative research:** only the best proposals will be selected by the European Commission. All domains of research are eligible!
- **You already have great achievements in research:** Curriculum Vitae is an important criterion of MSCA application.

Conditions of employment

Duration	12 to 24 months
Salary	Around €6 000 (fully loaded cost of employment) per month Exact salary to be published in the MSCA PF call in April 2025.
Support to mobility and family	mobility allowance (€ 710 per month) + family allowance (€ 660 per month) if applicable - both allowances are fully loaded cost of employment
Secondment	An interdisciplinary and/or intersectoral mobility (3 months up to 1/3 of fellowship) is possible **when relevant**
Additional benefits:	- Teleworking possible - 75% transport reimbursement - Sustainable mobility bonus (if cycling or car-pooling)

Selection process

How to apply to MSCA Postdoctoral Fellowship with Centrale Nantes:

Step 1: Find a supervisor at Centrale Nantes (application before March 31st, 2025)

- *Select a pre-determined topic*: You apply **in English** to one or two research subject(s) provided by supervisors (please see table 2 below) :
    - Detailed Curriculum Vitae (including list of publications);
    - A concise statement of research's relevance to the selected topic/duration, along with a detailed proposal outlining your project idea for the MSCA Postdoctoral Fellowship;
    - Link and/or information about your doctoral thesis;
    - Contact information of two references (not mandatory, recommended).

Please apply by sending your application to pauline.rouaud@ec-nantes.fr and yolaine.lebeau@ec-nantes.fr before **March 31st, 2025**. Please always include both contacts so that your request can be processed as quickly as possible.

If your application is retained (feedback at the latest: end of April 2025), then, the next step is to apply jointly to the MSCA PF (call launched by the European Commission - HORIZON-MSCA-2025-PF-01-01).

Step 2: Prepare the application to the MSCA PF

April-May 2025

- You receive an informative MSCA-PF starter package via an online meeting with advice on institutional aspects and horizontal issues (open science, gender, ethics and research data management…) - fellow + supervisors + EU project managers
- You elaborate jointly the research approach with your supervisor(s) (April 2025)

June 2025

- One joint meeting in Nantes. You receive a dedicated training session "Preparing for an Horizon Europe MSCA Postdoctoral Fellowship" advice on how to write your proposal - fellow + supervisors + EU project managers

July-August 2025

- Online meeting for proofreading - fellow + supervisors + EU project managers

September 2025

- Online meeting for administrative support for your MSCA PF application - fellow + supervisors + EU project managers
- We apply for you (deadline for the application: September 10th, 2025)

Please read this page to understand how MSCA PF works: https://marie-sklodowska-curie-actions.ec.europa.eu/actions/postdoctoral-fellowships/6-steps-to-prepare-your-application

Centrale Nantes is committed to equality and diversity. In line with our CSR commitments, this call is open to all.