PhD Position – Understanding Mineral Nucleation under Confinement (U-MIND)

Host Institutions: Institut Laue Langevin (ILL, employer), ISTerre (Université Grenoble Alpes & CNRS) and ICSM (CEA Marcoule)
Doctoral School: STEP – Earth, Environmental and Planetary Sciences (Univ. Grenoble Alpes)
Application Deadline: 30 June 2025
Starting Date: Autumn 2025

Project Overview

Mineral nucleation in confined environments (e.g., nanopores) plays a critical role in natural systems and sustainable technologies, including CO₂ sequestration and water desalination. These processes are influenced by nanoscale physico-chemical properties that differ significantly from bulk solutions. Recent studies suggest the existence of non-classical, multi-step nucleation pathways involving disordered precursors—but little is known about how these pathways operate under confinement.

The U-MIND project aims to uncover the fundamental mechanisms governing mineral nucleation under nanoconfinement. We will combine advanced neutron and X-ray scattering techniques with molecular modeling to investigate:

- Ion speciation and spatial organization in nanopores
- The influence of surfaces on nucleation pathways
- Transport properties and water-ion dynamics in confined systems

Candidate Profile

We are seeking a highly motivated student with a background in geochemistry, physical chemistry, materials science, or related fields. Experience in experimental techniques (e.g., scattering, spectroscopy, microscopy) and/or molecular modeling is a plus. Strong analytical skills and a keen interest in interdisciplinary research are essential.

PhD Activities

The PhD student will engage in:

- Molecular dynamics simulations to model ion behavior and nucleation processes
- Experimental design and execution at large-scale facilities (ILL, ESRF)
- Synthesis and characterization of mesoporous silica materials and nanochannels
- Advanced data analysis (e.g., total scattering, reflectivity, microscopy)
- Communication of results through publications and conferences

Contact & Application

For more information or to apply, please contact:

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- Dr. Diane Rebiscoul <u>diane.rebiscoul@cea.fr</u>
- Dr. Gabriel Cuello <u>cuello@ill.eu</u>

Applications should include a CV, a motivation letter, academic transcripts, and contact details of at least one referee.