

1.5 Year Postdoctoral position in active seismic tomography (VSP) using DAS data

Analysis and acquisition of active seismic data using DAS for imaging and monitoring the damaged zone around a large-diameter gallery at the Andra Underground Research Laboratory in Bure

Application must be in the form of a single PDF file including a CV, a cover letter, and the names and complete contact information of one referee, sent to:

Aurélien Mordret - aurmo@geus.dk

Philippe Guéguen - philippe.gueguen@univ-grenoble-alpes.fr

Application deadline: 30 April 1:00 PM CET

Expected Starting Date: June 2026 for 18 months duration

The Institute of Earth Sciences (ISTerre - <https://www.isterre.fr>) is a joint research unit hosted at the Université Grenoble Alpes in Grenoble (France). ISTerre studies the Earth from geological, physical, and chemical perspectives, combining observations, experiments, and modeling. The institute also contributes to national observation services and to the geophysical and geodetic data center (SDC) of EPOS-France. ISTerre staff supervise internships and PhD theses and co-develop academic programs. The institute is also committed to addressing societal challenges and fostering dialogue between science, technology, and society. ISTerre is recognized as one of the leading research laboratories in Earth Sciences in Europe.

The successful candidate will join the Waves and Structure team under the co-supervision of Philippe Guéguen (Research Director, Institute of Earth Sciences – ISTerre) and Aurélien Mordret (Professor at the Geological Survey of Denmark and Greenland (GEUS) / Associate Professor at ISTerre). The candidate will have the opportunity for some visit periods in Copenhagen at GEUS.

Scientific and Industrial Context

Studies at the Andra Underground Research Laboratory in Meuse / Haute-Marne (Bure) have defined the structure of excavation-induced fracturing and developed models based on gallery diameter and on gallery orientation relative to the major horizontal stress. This work distinguishes the Connected Fractured Zone (CFZ), mainly formed by extension fractures, and the Discrete Fractured Zone, formed by shear fractures. Since high permeabilities occur only in the CFZ, this zone is treated as the Excavation Damaged Zone (EDZ) for long-term safety assessments.

For Andra's **Cigéo** project, dedicated to the deep geological disposal of high-level and intermediate-level radioactive waste, the characterization of the CFZ geometry over time is a key parameter for assessing the preservation of the undisturbed Callovo-Oxfordian host rock and for evaluating the performance of sealing structures. The initial characterization, together with subsequent monitoring, aims to verify that any variations in the CFZ extent remain within the expected and predefined domain.

Conventional geotechnical methods (boreholes, in-situ tests) provide localized information but do not allow continuous, volumetric monitoring of the temporal evolution of the damaged zone. Distributed Acoustic Sensing (DAS) transforms a standard optical fiber into a dense array of virtual seismic sensors, offering decisive advantages:

- **Exceptional spatial density:** virtual sensors spaced every few tens of centimeters
- **Continuous coverage:** simultaneous measurements along the entire fiber length
- **Permanent installation:** repeated monitoring without heavy intervention
- **Robustness:** resilience under harsh underground conditions

Preliminary analyses have demonstrated the technical feasibility of using DAS to record high-quality active seismic data. However, methodological optimizations are required to fully exploit the potential of these datasets.

Job description

The main objective is to develop and validate a comprehensive methodology for 4D seismic imaging and monitoring of the EDZ using DAS, applicable to the operational context of the underground laboratory and ultimately deployable within the Andra Cigéo project.

Main Activities

- Maximize the exploitation of existing DAS datasets to produce a multi-attribute tomographic model of the EDZ
- Identify methodological limitations and optimize acquisition protocols
- Acquiring new datasets using an improved acquisition strategy
- Characterize the temporal evolution of the seismic properties of the EDZ over a 5-month period
- Assess the sensitivity of time-lapse monitoring methods by analyzing the influence of Earth tides at the underground laboratory site
- Develop transferable processing and interpretation tools for Andra. These tools will partially rely on the Geopsy software developed at ISTERre, a widely used open-source standard within the geophysical community
- Formulate operational recommendations for a long-term monitoring system
- Publish methodological advances and scientific findings with impact beyond Andra, benefiting the broader geophysical community

Requirements and Application

Required Qualifications (Priority Skills)

- Strong expertise in signal processing and seismic imaging
- Proficiency in scientific programming (Python, MATLAB, or equivalent)
- Solid experience with inversion methods and first-arrival seismic tomography
- Demonstrated ability to write scientific publications in English

Desired Qualifications (Assets)

- Experience with Distributed Acoustic Sensing (DAS) or borehole seismology
- Knowledge of Coda Wave Interferometry (CWI) for monitoring seismic velocity variations
- Familiarity with the Geopsy seismic processing software
- Experience in Vertical Seismic Profiling (VSP) data processing
- Background in geomechanics or geotechnical engineering
- Field experience and ability to manage acquisition campaigns

Professional Skills and Personal Attributes

- Scientific rigor and ability to work autonomously
- Ability to collaborate within a multidisciplinary team
- Strong scientific and technical communication skills
- Interest in industrial applications of research

Education and Experience

- PhD in geophysics, seismology, or a related field
- Experience in seismic data processing

ISTERre seeks to reflect on the diversity of society and welcomes applications from all qualified candidates, regardless of personal background or beliefs. We encourage applications from everyone irrespective of gender and ethnic group, but as women and members of ethnic minority groups are currently under-represented at this level of post, we would encourage applications from members of these groups. Appointment will be based on merit alone.

Contact name for information: Aurélien Mordret - aurmo@geus.dk