Laboratory simulation of periglacial processes
Post Doctoral position
2 years
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In periglacial areas, permafrost has been threatened by global scale warming over the last decades and especially by the Arctic amplification of air temperature increase in the high latitude Northern Hemisphere. Recent work has shown a significant increase in air and ground temperatures in the arctic since the late 1980s with a warming of the permafrost as well as a deepening of the active layer.

Those thermal modifications induce major changes in the mechanical and physico-chemical equilibria of frozen soils. Among them losses of mechanical stability inducing deformation at various degree (thermokarst, landslides, road deformation (e.g. Dalton highway)) and modification of the near surface water fluxes are observed, with major impacts on the local ecosystems (e.g. Plant species turnover). The understanding of those modifications are crucial for the climatic predictions at the global scale since those are now taking into account CO_2/CH_4 degassing feedback to active layer-permafrost thawing.

Many factors simultaneously work in the triggering of periglacial processes and their interdependence makes their analysis very difficult on the field (e.g. water content, temperature, grain size and texture) since we cannot constrain one parameter versus the others for sensibility analysis. This can be achieved in laboratory analog studies, as they provide the opportunity for more flexibility for the material and boundary conditions compared with what can be done from the field. In the last few decades, the use of frozen porous material saturated with water in a cold room aiming to study the impact of repeated freeze-thaw front is a well known approach for the understanding of the formation of ice segregation, cryosuction and cryoturbation processes.

The postdoctoral position is part of the ANR-funded “MODAFROST” (Modeling the Action of Seasons on Frozen Soils, P.I. Axelle Amon, IPR Rennes) project between 4 laboratories (IPR, IFADyFe, MSC and GEOPS) aiming to identify the physical origin of fluid and grain movements in presence of a moving freezing front in porous materials.

The purpose of that 2 year Post Doctoral position is to identify the main parameters involved in the transient layer formation (e.g. an ice-rich layer between the permafrost and the active layer). That transient layer is a new concept and plays a critical role in the thermodynamics of the frozen upper layers in periglacial environments. The experimental study in our cold rooms will

be performed to test the influence of different parameters in the formation of that transient layer and its influence on the degradation of the permafrost under warming conditions.

Responsibilities and requirements:

Since a decade, in the GEOPS Laboratory (Paris-Saclay University), physical modeling has been developed in order to simulate the development of periglacial processes observed over terrestrial arctic regions at submetric-scale. The major purpose of the Post Doctoral position will be to examine the respective effect of material, active layer thickness and transient layer evolution, time and intensity of freezing-thawing cycles and permafrost characteristics for observing and quantifying granular movements and grain redistribution at macroscopic scale. To this end, freeze-thaw cycles in sub-metric sized box filled with polydisperse colored saturated/unsaturated media experiments will be carried and monitored with various sensors.
The post doc will use different geophysical instruments such as thermal-, optical-, 3D laser scanning-, deformation- sensors, most of them Raspberry-Pi/SBC based and other geophysical methods such as GPR for the detection of the interfaces within the frozen soil.
While there is a planned work-schedule, this can be adjusted to fit the skills of the post-doctoral researchers, who are expected to contribute to the success of the project with their own research ideas. The researchers are expected to present results on national and international conferences, as well as publish in peer-reviewed journals. For these tasks, demonstrated experience in scientific writing and communication in English is a must. The French language is desirable but not mandatory.
The Postdoc must hold a PhD degree. A background in geology/geophysics/physics and/or scientific computing/IEEE is desirable, but not mandatory. The ideal candidate is highly motivated to develop laboratory-scaled experiments and the associated sensor network (temperature, deformation and optics). The expected granular movements are subtle, and high precision analyses require tedious work and precision in all the aspects/stages of the experiments. Some of the methods will be further improved within the framework of this project, which requires technical skills, ideally including programing and IEEE development.

Interested applicants should email their application in pdf format to Emmanuel Léger and Francois Costard by **1st december 2024 at the latest**.
(emmanuel.leger@universite-paris-saclay.fr and francois.costard@universite-paris-saclay.fr).

The expected start date is spring 2025.

Please provide a single pdf including:

- 1-2-page cover letter outlining your academic background and skillset, the reasons you are interested in the project, and other points of relevance
- CV and academic transcript (a copy of your M.Sc. and PhD degree certificates and any other relevant documents)
- Contact details of one or two former advisors or supervisors (referees)

Once shortlisted, we will arrange for a videoconference or in-person interview.