

## Training (5 months / February – June 2014)

Technical unit home: IFSTTAR Marne la Vallée (east of Paris)

Geotechnical engineering, environment, natural hazard and earth sciences department (GERS)  
Soils, rocks and geotechnical structures group (SRO)

<http://www.ifsttar.fr>

### **The effect of dry-wet cycles coupled with temperature change on clayey soils behaviour. Application to the sub-surface geothermal domain.**

The number of subsurface geothermal systems increases as they provide a renewable energy allowing to save traditional energy. However, these systems generate changes in soil temperature: an increase in summer to refresh houses and a cooling in winter (note that the soil may frost in some cases if the system is not well designed). Considering the succession of temperature cycles throughout the life of the geothermal system combined with the soil water variation, we expect some changes in mechanical soil properties related to the microstructural change. Parallel to thermal change, the soil water content varies with the season, the weather but also with the presence of vegetation and when clays are present in soil, the changes in humidity can cause differential settlement under the house foundations. Now, we wonder if the presence of a geothermal plant near the house can or not affect the swelling and shrinking phenomenon at the origin of pathologies on individual buildings.

The goal of the training is to contribute experimentally to better understand the effects of temperature changes (between around 3-5° to 50°C) coupled with humidification and drying cycles on the shrinkage and swelling of clayey soils. After a literature review on the shrink-swell phenomenon (potential and swelling pressure, cracks, microstructure of expansive soils, shrinkage potential,...), the work will consist in setting up an experimental device using a triaxial cell coupled to a heating system. The next step will be to test the device on model materials by developing a methodology to highlight the role of temperature on soil behavior. Finally, an experimental plan may be elaborated by detailing how to make sample with remold clayey soil, the soil conditioning in different states - for example a soil may have undergone a freeze-thaw under confinement before the step of swelling-shrinkage). Then a first test will be started. As such tests are supposed to be very long, simple tests of swelling-shrinkage in unconfined conditions or in a confined cell placed in water or in an oven will be applied. Microstructural observations (electronic microscopy, X-ray diffraction and porosimetry) should give complementary information and explain the change on the measured volumetric strain.

The candidate student must be autonomous and highly motivated by this work. He will be able to manage the research and propose some ideas without a permanent supervising. He will have a good experimental skill and will like working on material, asking questions and proposing ideas to solve the problem considering his knowledge from previous studies. The understanding of written documents in French will be appreciated.

**Compensation for training** : yes

#### **Contact :**

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