



## **Quantifying surface erosion in the Centre de Stockage de la Manche as a function of cover material properties and rainfall regime**

### **1. Context of the PhD – CIFRE grant**

Research Lab: **MINES ParisTech**, PSL Research University, Centre de Géosciences, 35 rue St Honoré, 77305 Fontainebleau Cedex, France (Director: Vincent Lagneau) – Industrial partner: **WSP France SAS** 100C, allée Saint-Exupéry 38330 Montbonnot Saint Martin France

PhD supervisor : **Jean-Alain Fleurisson**

Other supervisors : **Jean-Louis Grimaud**, (MINES ParisTech); **Olivier Stab** (MINES ParisTech) ; Olivier BENOIT (WSP), Matthieu VERSTAEVEL (WSP), Daniel REY (WSP)

### **2. Scientific contact: [jean-louis.grimaud@mines-paristech.fr](mailto:jean-louis.grimaud@mines-paristech.fr)**

### **3. Description of the project**

The Andra CSM (Centre de Stockage de la Manche) is the oldest nuclear wastes storage site of France. It was in use from 1969 to 1994. Since then, 527 225 m<sup>3</sup> of nuclear waste of low and medium activity have been stored in a 10 hectares area. The CSM is still monitored by the Andra. In order to limit environmental and sanitary risks, the geological cover of this site must (i) prevent underground water transfer and (ii) protect physical denudation down to the waste compartment. The aim of the PhD is to further ensure the long-term (several hundreds of years) resilience of the geological cover from hydraulic erosion as a function of Climate change and associated modifications of rainfall patterns. In this context, it is necessary to ensure that any hypothetical thickness loss of the cover will be minimal.

During this PhD, a reduced-scale erosion device will be build in the Geomorphic Lab of Fontainebleau in order to explore the response of the soils in place in the CSM to external climatic perturbations. These experiments will allow describing and quantifying the initiation and development of erosion processes at the surface. A first experimental device will allow testing several rainfall regimes as well as different geometry (slopes) of the cover in order to study rill formation and to identify potential thresholds (rainfall intensity, droplet size, slope) at which the material is being eroded. The erosion geometry will be tested as a function of material properties and climatic scenarios. The second experimental device will allow looking at water flow erosion more locally in the rills as well as the adjustment of rills longitudinal profile.

In these experiments, perturbed climatic scenarios will be converted into characteristic rainfall events that will be applied to the CSM cover material. Several scenarios will be tested including desiccation processes in order to test the impact of wet-dry cycles on the material. The results of this study will allow setting up a larger experimental device, closer to the scale of a storage site.

#### 4. Compétences et connaissances requises

The candidate will have a good background in physics, in particular regarding soil mechanics and/or erosion processes. He/she will be comfortable with fieldwork and -above all- laboratory work. The candidate will be involved in the design and set up of the experimental devices. Some knowledge on the soil parameters measurements will be greatly appreciated. Finally, knowledge in geology and (paleo)climate will be assimilated during the PhD to place the results in their broader context.

The PhD will be held both in Fontainebleau (2 years) and WSP (1 year). Fieldwork will be realized in the CSM and comparable storage sites in Europe. At the end of the PhD, the candidate will have the opportunity to be recruited by WSP.

**Visa de la Direction de l'Unité**

**Commentaires éventuels :**