PhD position in Experimental analysis of gypsum dissolution

Quantification of particles transport processes in growth of dissolution gypsum cavities

Key words

Chemical water-rock interactions, ground movements, kinetics of dissolution, laboratory, gypsum, hydrogeology, geomechanicial issues, multiscales, multiphysics

Abstract

The objective of this PhD project is to study, mainly experimentally, the mechanisms of mass transfer of porous gypsum subjected to porous water flow. If the main mechanism of cavity growth is the dissolution of the mineral phase in contact with the under-saturated fluid, the nature of the water flow and/or the restructuration of the rock induced by the dissolution are at the origin of a non-negligible part of the cavity growth. These mechanisms are not well known and have to be evaluated accurately in order to quantify their contribution in the rate of growing of gypsum cavity form onset to collapse.

In particular, in the case of grainstone gypsum, the dissolution of the inter-grains cement and their advection by flow can significantly increase the rate of growth of the cavity. The understanding of these chemico-physical processes will enhance the management of risks linked to theses kind of geological processes which are common but not well known.

Context and target of the PhD position

For about ten years, INERIS has been working on the behavior of dissolution geological systems involving gypsum layers. Understanding the functioning of these geological environments allows us to propose some methodologies in order to evaluate the hazard induced in such particular geological contexts. Our recent findings suggest that the dissolution process of gypsum, alone, does not allow to explain the occurrence of observed disorders occurring at soil surface. The goal of this study is to improve the knowledge of mechanisms involved in such problem.

Scientific and operational issues

Gypsum is a mineral with moderate solubility. This implies that the process of dissolution in itself breaks down into several physical mechanisms which each have their own kinetics. The setting up of laboratory experiments to meet the objectives of the work is an issue in itself.

At a larger spatial scale (in-situ scale) the main operational challenge is to better evaluate the kinetics of creation of dissolution voids, in some active dissolution area. This better quantification will allows us to evaluate the time evolution of such cavity and underground disturbances and finally improve the currents hazard maps.

Job description

The work will be focused on the gypsum saccharoid facies frequently encountered in the basement of Paris area. An experimental approach will be used to characterize and quantify the mechanism of mass transfer by dissolution as a function of water flow, the chemistry of the solution, and the petrophysical characteristics of the gypsum samples.
The mechanism of grain transport, which is the core of the research work, will be studied from the development of laboratory devices and protocols to visualize and quantify the loss of grain with various flow conditions leading to the destruction of the samples.
This laboratory work will be based on existing protocols and devices to quantify the dissolution of soluble rocks developed at the Geosciences center of MINES ParisTech (France). The analysis of the results obtained will allows us to define a global relationship between the rate of loss of solid mass integrating the mechanism studied and dissolution process. This relationship will be incorporated into existing models to assess deviations from dissolution alone, and improved the last one.

Institute/ Departments

INERIS (Institute National de l'ENvironnement industriel et des RISques) is an EPCIP (French public research body of an industrial and commercial character), under the aegis of the French Ministry of Ecology

MINES ParisTech: ParisTech is a collective entity that includes 12 of the most prestigious French institutes of education and research

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