



## **Development of a Coupled Thermo-Hydro Model to study the Impact of Permafrost on a Groundwater Flow System – Application to a sectorial cross cut at the Andra MHM site (NE France)**

D. REGNIER (1), C. GRENIER (1), H. BENABDERRAHMANE (2), and P. DAVY (3)

(1) LSCE, UMR CEA-CNRS-UVSQ, Orme des Merisiers, 91191 Gif-sur-Yvette Cedex, France, (2) ANDRA, Parc de la Croix Blanche, 1-7 rue Jean Monnet, 92298 Châtenay-Malabry Cedex, France, (3) Géosciences Rennes, UMR CNRS 6118, Université de Rennes 1, 35042 Rennes Cedex, France

Within the framework of Nuclear Waste Storage, the assessment of the impact of climatic cycles on the host geological formation is a major issue. The present work follows former studies related with the Meuse / Haute-Marne Andra site located in the North-Eastern part of France, in the Parisian sedimentary basin. A 60 km \* 40 km zone was modelled around the site comprising 6 sedimentary formations roughly down to a depth of 800 m.

In a first approach, the impact of permafrost evolution on the underground flow patterns was studied over a 120 Ky time period considering a series of permafrost maps issued from an expert view. In a second approach, thermal evolution of the formation is modelled considering heat conduction, phase change (water-ice), advection, formation properties, local geothermal flux and climate signal.

We present here the development of a novel simulation approach including coupled Darcy flow and heat transport within Cast3M code with a Mixed-Hybrid Finite Element scheme. The approach is validated against analytical solutions and bench mark cases issued from the literature. A cross section of the MHM site is studied for a climatic cycle, including a basic topographic unit (valley, river, plateau) and the related geological formations.