



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)

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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.