Geosci. Model Dev. Discuss., 7, C2634–C2636, 2014
www.geosci-model-dev-discuss.net/7/C2634/2014/

Geoscientific Model Development Discussions
Open Access

GMDD
7, C2634–C2636, 2014

Interactive Comment

Interactive comment on "Thermo-hydro-mechanical processes in fractured rock formations during glacial advance" *by* A. P. S. Selvadurai et al.

F D Darve

felix.darve@grenoble-inp.fr

Received and published: 9 December 2014

Referee comment on paper Âń thermo-hydro-mechanical processes in fractured rock formations during glacial advance Âż

In modern geosciences, numerical modelling plays a more and more important role to analyse and understand the extreme complexity which is observed in the real geoworld. Anyway many difficulties are and will be encountered in relation with these computations, like (i) the intricate visco-elasto-plastic behaviour of the involved geomaterials, (ii) the very large deformations and flows of these media during the geologic history, sometimes accompanied by fluid/solid transitions and vice-versa and (iii) the chemo-thermo-hydro-mechanical couplings always active in these geomaterials. This pioneering paper is focused on one of these essential key points which is constituted by the modelling of the thermo-hydro-mechanical processes in fractured rocks in the perspective of a secure development of nuclear waste disposals.

Indeed the development of methodologies for the safe disposal of high level nuclear waste is important to many industrialized countries. The use of nuclear energy is looked upon as a green energy, provided, the harmful by-products can be safely stored or disposed permanently without an impact on the environment. At present the waste is stored at the reactor sites and this is an unacceptable situation because of the ageing reactor infrastructure (Chernobyl, Three Mile Island), natural disasters (Fukushima), security risks (ISIS) and the location of reactors close to large human populations.

By far the most widely accepted strategy for disposal of highly radioactive wastes is the deep geologic disposal of spent fuel in rock formation that will provide the conditions necessary for minimizing the risks associated for the release of radionuclides to the environment at acceptable levels. This involves sound geomechanics contributions where the multiphysics of thermal, mechanical and fluid flow processes can be adequately examined. The basic approaches for examining thermo-hydro-mechanical process in geomaterials is thus an essential requirement for predicting the long term reliability of deep geologic strategies.

The longevity of the radioactivity implies that the behaviour of repository needs to be examined at time scales of the order of 10,000 years and should take into consideration geomorphological changes that can occur at these time scales. Glaciation is an important consideration in the long term behaviour of a deep geologic repository. The integrity of the rock formation during glaciation loadings is regarded as a criterion for assessment of the feasibility of long tem storage.

Rock formations that are suitable for the location of deep geologic repositories should be free of defects such as fractures, inclusions and other heterogeneities that can form pathways for the premature leakage of radioactive materials. Unfortunately all natural geologic formations have defects and their effects on the repository behaviour can be significant.

The approach to deep geologic disposal requires mathematical and computational models that can address multiphysical phenomena in heterogeneous formations that contain defects. This approach has also to take into account processes that can accommodate heating effects of the stored waste and environmental phenomena such as glaciation loadings that can occur in times scales that are beyond the range of conventional engineering approaches and the application of the usual "Scientific Method". So this basic contribution is an attempt to examine the influence of glacial loadings on the performance of a fractured rock mass which is subjected to thermo-hydro-mechanical phenomena. It provides the background necessary to make further advances in the scientific approach to deep geological disposal concepts, essentially because it takes into account both the fractured character of rocks and the main multi-physics couplings acting in these problems. Finally let us note that these methodology and numerical tools can also be applied to geologic sequestration of greenhouse gases, energy resource extraction by means of hydraulic fracturing and geothermal energy extraction from fractured formations.

Félix DARVE, Grenoble Alpes University, Grenoble INP, 3SR lab - France

---

Interactive comment on Geosci. Model Dev. Discuss., 7, 7351, 2014.