

Interactive comment on

“Thermo-hydro-mechanical processes in fractured rock formations during glacial advance” by A. P. S. Selvadurai et al.

Anonymous Referee #1

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General comments

This excellent manuscript illustrates the thermo-hydro-mechanical as well as hydro-mechanical processes emerging through glacial advances. It thus investigates important scenarios in view of nuclear waste management, i.e. storage in the subsurface, which is a highly-debated problem in countries that were affected by glaciation at least once in the last 20,000 years. The paper though does not consider the overall glaciation process and consequently its large-scale effects known as glacial isostatic adjustment (GIA), but it presents assuming a linear problem temporal and spatial changes of several parameters induced by further advance of an already existing ice sheet.

C3283

The manuscript is well written and the reader is guided through the sections. Figures are appropriate and visualize the results nicely. I liked reading this paper and I am willing to recommend its eventual publication subject to a minor revision dealing with the few comments to follow. I hope these comments will further enhance the already excellent quality of the manuscript, provide a bit more information to the reader and perhaps broaden the readership as well.

Specific comments

Introduction: Although this is very thorough introduction citing a lot of previous work, I personally see it a bit too long. Especially page 7355 and lines 1-24 of page 7356 could be moved to later sections describing the model set-up and dedicated equations. Also, it was unclear to me until page 7360, lines 14-16, that you only model a small glacier advance (thus there is already a glacial load on the model). Please highlight that in the introduction.

Section 2: Please state if the final equations are solved by COMSOL exactly that way or if you had to modify the software. The same on page 7368, lines 1-3.

Section 3: Is the fracture network random? Does it represent a typical example? If so, for what? Please quantify the "most" on page 7361. Fractures as stated here have mostly "most" characteristics, so they appear to be all the same!?!

Section 3.3: Please provide references for the chosen values! Are they realistic? The ice sheet appears to represent the last glaciation of North America, but I find a glacier advance in 5900 years very slow.

Section 3.4: What is "a reasonable time frame" in hours/days?

Section 3.5: Please provide references for these values!

Figures 4 and 5: I suggest another figure to each figure showing the behavior of the quantity along a profile in the model in a certain depth (or at the surface), so that the reader can see the overlap/difference better.

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Section 5.1: Page 7369, lines 22-24; Please provide reference! Page 7370, last sentence: I suppose with "stress state resulting from glacial loading" you refer to the stress obtained for the advance. However, for a full analysis it should be combined not only with geostatic stress, but also with the GIA stress (see Steffen et al. 2014) and possible tectonic background stresses.

Section 5.2: 1 047 000 years is a very long time. Please put this in a realistic context. Or is your study basically a preliminary numerical study?

Section 6: The two paragraphs on page 7373 should be discussed in view of former results and other works, or further highlight what is new from this study. Page 7374, line 10 ff.: also the activation of faults is worth studying, e.g. in a combined analysis with large scale models of GIA.

Appendix: Parts are repetition of section 3.3. Please just mention what is really needed in each section.

Technical comments

None.

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