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Hydrology and Earth System Sciences Discussions

Interactive comment on "Infiltrative instability near topography with implication for the drainage of soluble rocks" *by* P. Genthon and A. Ormond

Anonymous Referee #3

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General Comments

The article studies the instabilities of dissolution of minerals by means of numerical modeling. The model couples precipitation with porosity and permeability change. Effects of Peclet and Damköhler are studied through a sensitivity analysis. The subject is relevant for HESSD and hydrogeology in general. On the whole, the article is well written with exception of the model equations (see specific comments 2 and 3). Also I have some doubts on the effect of the initial distribution of high permeability slots (see specific comment 5).

Specific comments

1. Page 703, line 14-15: You say that you model a homogeneous medium. However,

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this may be misleading, because you use a distribution of high permeability slots, which makes the medium initially heterogeneous. So, in my view, instability doesn't work "by itself".

2. Page 704, equation 2. In the first term you divide by the porosity. Is this correct? If yes, it has to be explained, because it is not the normal way of writing the transport equation.

3. Page 705, equation 4, 5 and 6. I suppose v' and C' are the dimensionless velocity and concentration. However, v' doesn't seem to be dimensionless. By using the definition of v_0 and P', it can be deduced that: v' = v/(v_0h), that means, it has dimension of length^{-1}. The last term of the right hand side of equation 5 has no dimension (if C' is dimensionless) whereas the other terms have dimension length^{-2} (if v' = (v_0h)). Could you clarify this?

4. Page 708, equation 8 and 9. According to me, equation 8 holds when calcite concentration is zero and 9 holds when the mineral concentration is higher than zero. However, you they hold when the porosity equals one, is smaller than 1, respectively. Porosity is somehow related to mineral concentration, but I cannot see this relation. Could you explain it?

5. Page 710, line 15. You use a distribution of high permeability slots. Could you be a more specific on this or give some statistical characteristics (mean permeability, variation, variograms, ...). Does the various slot distributions, that give similar finger distributions, have similar or different statistical characteristics? I think this is important, because I guess (but of course I can be wrong) that a slot distribution, that is too homogeneous, would not lead to fingering.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 5, 701, 2008.

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