Hydrol. Earth Syst. Sci. Discuss., 10, C8031–C8033, 2014
www.hydrol-earth-syst-sci-discuss.net/10/C8031/2014/

Hydrology and Earth System Sciences
Open Access
Discussions

Interactive comment on "Simulation of rock salt dissolution and its impact on land subsidence" *by* A. Zidane et al.

Anonymous Referee #2

Received and published: 26 February 2014

The authors present a numerical model to describe the dissolution process in stratified salt deposits of the Jura mountains. Subsidence as a consequence to the subsurface dissolution process poses a substantial geotechnical problem.

Since I am not an expert in the numerical solution approach, I shall just concentrate in my review on the general concept and the interpretation of the results.

Based on a two dimensional schematic cross-section the authors simulate the salt dissolution process for different geometric configurations of a layered aquifer system, consisting of a tight base (salt), a permeable bedding plane (horizontal "fracture") and an overlying continuum porous aquifer. For the mathematical model, the Crouzeix-Raviart approximation was coupled to a salt dissolution module, applying a forward

modelling approach. The geometric and hydrogeological set-up simplifies that of the Muttenz-Pratteln area of the Swiss Jura Mountains.

Various types of boundary conditions, represented by permeable fault zones either side of different hydraulic and geometric properties, were applied and the effect on dissolved salt mass and subsidence investigated. In the forward modelling studies, the respective importance of the transmissivity of the vertical fault zone and the regional (between fault zones) and local (between the western fault zone and local abstraction well) flow regime is investigated.

The manuscript investigates an area that is innovative, relevant and highly interesting and in that respect it is definitely suited to be published in HESS. The subject is however highly difficult to investigate because of the large number of factors, variables and boundary conditions that potentially influence the resulting modelling outcome.

I do highly recommend that this manuscript is published in HESS because of the above reasons. The authors however should address a number of different aspects that possibly contribute a great deal to readability and understanding. To a large extent, the subject is approached phenomenologically, it would deserve a more systematic approach. I am aware that this is difficult to achieve satisfactorily but an attempt should be made at least in that direction since a powerful model is available.

In the following a few suggestions / questions:

1.)What is the relative importance of the main factors / parameters / boundary conditions, contributing to regional dissolution process a) regional flow field, b) local flow field, vertical transmissivity of fault zones, permeability of overlying aquifer, transmissivity of bedding plane "fracture", hydraulic gradients of regional fault-fault / fault borehole configurations, etc. There might be others. I am of the opinion that a more systematic parameter study should be attempted.

2.)Please address the long-term effect of the salt dissolution (steady state conditions).

Is the initial rapid dissolution a boundary, initial condition effect (modelling artefact?)? The more relevant results are those of the long-term dissolution process and should be stated as such. The comparison of the field observation with the simulated data should be on this basis.

3.)Address aspects of (absence) dissolution kinetics.

4.)Provide detailed figure of local flow patterns / concentration distribution between well and fault zone. Such a diagram would highly contribute to the reader's understanding of what's going on. It could also include a diagram of the spatial distribution of mass flux.

5.)The structure of the manuscript is great, as well as the presented diagrams (please add a figure, described in 4.)). Attention should be paid to spelling and a few "unusual" terminology, such as:

a.p.12256, L6 - "reactive fractures" – unusual expression

b.L16 – "vertical mass loss" rather than "vertical dissolution"

c.L23 – "undersaturated" rather than "sub-saturated"??

d. ......

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 12255, 2013.