Hydrol. Earth Syst. Sci. Discuss.,
doi:10.5194/hess-2016-663-RC2, 2017

Hydrology and Earth System Sciences
Discussions

Interactive comment on "Transport and degradation of perchlorate in deep vadose zone: implications from direct observations during bioremediation treatment" *by* Ofer Dahan et al.

M Vanclooster (Referee)

marnik.vanclooster@uclouvain.be

Received and published: 27 February 2017

General comments This paper describes an interesting large-scale vadose zone infiltration experiment, aiming to drive and understand the transport of a perchlorate pollution plume in a 40 m thick vadose zone. In the experiment, 3 ethanol-enriched water infiltration pulses are applied to a limited field site by means of a regularly distributed drip irrigation system. Water content, perchlorate content, chloride content and DOC is monitored at different depths (11 stations) by means of a VMS system designed in a previous work. Results of the monitoring allow elucidating depth-time patterns of water, perchlorate, chloride, TDS and DOC which conceptually are related to perchlorate transport and degradation. The conceptual results are suggested to be used in the

Printer-friendly version

Discussion paper

design of the perchlorate remediation process.

The paper enters in the scope of the journal. The paper is original since very few large scale experiments are reported allowing to monitor the fate of pollution plumes throughout the vadose zone during the pollution remediation process. Yet, although the experimental work is impressive, the study lacks some details and conceptual founding for accepting this study in this stage as a full publication in HESS. The major concerns are i) the absence of any quantitative modelling of the water transport and/or the perchlorate pollution plume during the infiltration experiment; ii) the absence of any uncertainty assessment. Hypothesis related to the fate of the perchlorate plume are indeed subjected to the hypothesis of mass conservation and representativity of the singular sampling. These strong hypotheses can only be considered acceptable in the present case if the experimental results are compared with some quantitative modelling that are built on mass conservation principles (using e.g. a numerical water and solute transport, or NAPL/DNAPL transport model). As long as this numerical modelling is not added to the paper, the results remain too much speculative. I, therefore, recommend rejection of the paper in the current form, but with a strong recommendation to resubmit the paper in which a numerical modelling component has been added.

Specific comments

Line 103. Study site. Can the origin of perchlorate in the study site be identified?

Line 121. Heterogeneity in sedimentary vadose zone formations is omnipresent. Hence, how reliable is the single borehole to assess the lithology of the study site. Is the information of the borehole consistent with information obtained from the boreholes in the vicinity of the sampling point?

Line 152. The high suspected correlation between chloride and perchlorate concentrations demonstrates that there is some natural attenuation. This is in contrast with the statement in the literature review (line 86).

Line 198. Explain more in detail how ethanol can eliminate increased salinity.

Line 214. Specify for each infiltration pulse how much time was needed to apply the water/tracer/ethanol (hence the application rates). Also, add an estimate of the saturated hydraulic conductivity of the different layers to demonstrate that the infiltration rates stayed sufficiently below the ponding infiltration rate.

Line 250. Significant at which statistical level?

Line 287. Specify exactly how the wetting front velocities are determined. We are definitely in strong transient flow conditions. Hence the wetting front velocities will vary dynamically in time.

Line 290. Be more rigorous and more specific with respect to 'flow velocities'. How are these "flow velocities" defined in a heterogeneous and time dynamic flow system? (Cf. a major concern on the need to confront such statements with those from a quantitative numerical model).

Line 302. Legend incomplete. What are the different coloured curves? Where are the results of the 11 sampling units? Quid results of the control units in the top layer (0,5 and 1.3 m depths)?

Line 302. Explain more in detail the observed curves. E.g. what happens with the TDR probe at the top (I suppose) during the third infiltration event? The drainage curve looks completely different. So what happened?

Line 356. This statement can't be supported. This can only be concluded if mass conservation is checked. You can have lateral flow dissipation in such system. Only, a comparison of the results with the results of a numerical mass conservative model can support such conclusions.

Line 400-402. Show this in an explicit way.

Line 426. Confusing legend. 1/3 -11/4 2011. Specify which data at which date exactly.

Line 451. There are other studies showing that the clay layers will have considerable impact on the vadose zone dispersion (See e.g. Javaux M. and M. Vanclooster, 2004. In situ long-term chloride transport through a layered, non-saturated subsoil.1. Data set, interpolation methodology and results. Vadose zone journal 3 : 1331-1339.).

Line 461. This has not been shown in the paper.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., doi:10.5194/hess-2016-663, 2017.

Printer-friendly version

Discussion paper