

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

Anonymous Referee #1

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General comments

The authors present results of an experimental approach for remediating a polluted site. They made use of microbial processes in the deeper parts of the soil for reducing perchlorate pollution within the vadose zone triggered by the application of ethanol as electron-donor. The success of the infiltration and of the perchlorate reduction was monitored by means of a vadose zone monitoring systems. This system allows for a continuous observation of soil moisture and the sampling of soil solution in different depths. The experiment was carried out in three steps with increasing quantities of water and ethanol. First results showed that the initially applied water and ethanol quantities were not sufficient for a deep infiltration into the polluted zone of the soil.

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The results indicate that both infiltration and perchlorate reduction could be triggered at least after the third application.

The presented topic is of relevance for many sites worldwide, polluted with different chemicals which can be deactivated by microbial processes. The specific challenge of this approach was the location of the pollution within a deep vadose zone with complicated water flow conditions. In addition, the chosen approach was based on natural seepage and not on a forced washing of the soil by infiltration wells. Thus, the topic is scientifically interesting and seems to be relevant for publication in HESS.

The paper is generally well-written and of good quality with a language which is concise and well understandable. The experimental setup as well as the results is presented clearly. The conclusions are generally comprehensible and objective.

However, with regard to the order and content of the subsections some improvement for a better understandability could be made. Some context would be easier to understand if the order of subsections would be rearranged. For example: Section 4.3 explains why the different treatments for the experiments were chosen, because the infiltration depth was not sufficient in the beginning and the concentration of ethanol was too low during the first experiment. It would be good to have this information already in the beginning before the results of perchlorate transformation are shown and discussed. The same is true for the presentation of bromide tracer behavior (in the beginning of section 4.4) which again explains the experimental setup. Please think about a change in the order of these parts of the results chapter.

Specific comments

p. 5, l. 111: You state that perchlorate is slowly leached into the groundwater. Can you describe the behavior of this pollutant in the saturated zone? Is it reduced or only transported by groundwater flows?

p. 6, l. 147: What is the effect of these climatic conditions? Is the perchlorate only

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transported during the winter season and probably rises again during summer due to capillary action?

p. 11, l. 229: Please explain why no tracer was used in the second and third application.

p. 12, l. 272 Can you exclude lateral fluxes of seepage water?

p. 15, l. 326: Is the described successful reduction of perchlorate concentration the result of transport or reduction processes? Would it be a success if perchlorate is mainly transported by seepage water into deeper parts of the soil?

p. 16, l. 333: You mention mixed trends for both transformation and mobilization processes. Could you explain this conclusion more in detail?

p. 17, l. 350: Probably the relation between ethanol concentration and DOC could be shown by means of a figure and a regression curve?

p. 21, fig. 8: Is the red graph an average for data of the period 1/3-11/4 2015 (1.5 months)?

p. 22, l. 459: You end up with the conclusion that the entire column of perchlorate was pushed downwards by the infiltrating water. Thus, the problem is mainly shifted to the groundwater. Could you discuss the overall success of the presented remediation experiment against this background?

Technical corrections

References: Bauterse et al (2000) and Stumpp et al. (2009) are not mentioned in the text

Fig. 3: the legend is missing

Fig. 4/5: explain the meaning of the red arrows

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