

Interactive comment on “Predicting the denitrification capacity of sandy aquifers from in situ measurements using push-pull ^{15}N tracer tests” by W. Eschenbach and R. Well

Anonymous Referee #2

Received and published: 6 January 2015

General comments

This paper makes a valuable contribution to groundwater denitrification research, particularly by linking the results of in situ push-pull ^{15}N tracer tests to laboratory-derived denitrification rates and to measured stocks of reduced compounds. Applying push-pull ^{15}N tracer tests in varying hydrochemical settings also provided useful information on the limitations of such short-term tests. While the research was restricted to two sandy aquifers within the same region, the results will be of great interest to the international science community.

Specific comments

C7842

Please consider reformulating the following sentences or paragraphs to clarify their meaning:

1. 16529-18 to 22: Logic of ‘not only..’ and ‘Since’ not clear.
2. 16532-6 to 9: Presumably referring to the so far insufficiently considered effect of ambient redox conditions on the outcome of push-pull tests, but unclear.
3. 16549-13 to 18: This paragraph on temporal (in addition to spatial) variation appears somewhat isolated in this section, as you do not explicitly refer to its relevance for your study. See comment on ‘steepest increase’ below and Figure 2. It also should be noted that temporal variability may have had an effect on the comparison between push-pull test without and with pre-conditioning (16550 and Fig. 4).
4. 16549/50 Section 4.1.2: The headline does not appear to describe the four main issues discussed in this paragraph adequately (push-pull nitrate-free zone, pre-conditioning, difference between in situ and lab results, in situ vs. lab ratios). Maybe start with push-pull results from nitrate-bearing vs. nitrate-free zone and develop line of argument from there?
5. 16555-25 to 16556-2: The meaning of this sentence is not clear to me. Please reformulate.
6. 16556-6 to 8: You correctly refer here to nitrate-bearing aquifer zones. Equally, I suggest to repeat here that the push-pull technique (without pre-conditioning) not suited to conditions where the groundwater is nitrate-free.
7. Table 1: Replace ‘depth position’ by ‘depth’ or ‘location’. Clarify why one specific depth is given in some instances, but a range in others. Given that screen lengths varied widely between wells, I suggest the depth range should be given everywhere.
8. Table 2: As previous comment. ‘Injection depth’ information unclear.
9. Figure 1: the schematic suggests that the injection depth (i.e. end of pipe) was at the top of the screen. If this is correct, have you considered the effect of the varying screen lengths (0.25 m for CMT system, 1 – 4 m for monitoring wells)?
10. Figure 2: I would recommend enlarging these four figures, particularly the bottom ones. The legend suggests that there should be a ‘FFA ns’ time course, but that does not appear to be the case. Please clarify. Also, the tZ symbol is somewhat difficult to recognise; please consider changing it.

C7843

The manuscript would benefit from providing additional information on the following issues:

1. 16536-18: Please provide some information on the length of time required for the passive tracer solution injection at the various sites. Given the differences in screen dimensions, tracer volumes and aquifer properties, is it fair to assume that these times varied widely? 2. 16541-9: What was the range of dilution factors encountered at the various sites? 3. 16541-16: Please explain the rationale behind using the 'time intervals with the steepest increase'? What is the effect of differing time intervals and differing reaction dynamics (e.g. nearly linear vs exponential) on this procedure? 4. 16542-9 ff: The reported CV values appear very low if they are indeed percentages. Please double-check that they are not fractions. 5. 16544-9 ff: This section is somewhat confusing as the two different procedures to stratify the data and the relationship between the two are not well explained. Rather than referring to your earlier paper, please explicitly provide the missing information here (e.g. give the threshold you used to separate nitrate-bearing and nitrate-free groundwater). Moreover, replace 'sub data sets'; maybe use 'data subsets' instead? 6. 16556-9: This sentence is reinforcing the earlier comment that some information on variability of bromide recovery across the sites is required. 7. 16555-11 to 14: The 'transition zone' is sulphidic but still contains nitrate, suggesting that denitrification may be active in situ. I suggest you could more explicitly link the experimental results, and the differences between the data subsets, to the redox processes that are likely to be active under ambient conditions in situ.

Technical corrections

Unfortunately, convoluted and imprecise language distracts from the high quality of the manuscript. It is recommended that the authors enlist the support of a native speaker to overcome this shortcoming.

In the following, please find a list of the most obvious typing or grammatical errors:

1. 'were' repeatedly needs to be replaced by 'where': 16530-21, 16547-24, 16554-27, C7844

16556-8. 2. 16530-12: Please replace 'surface near groundwater' with a more appropriate term. Maybe 'uppermost groundwater' if you refer to the groundwater zone closest to the water table or 'shallow groundwater' or 'near-surface groundwater' if you are referring to groundwater near the ground surface (i.e. situations with shallow vadose zone). Equally in 16531-11. 3. 16531-2: Consider replacing 'instrument' with 'technique'. 4. 16531-18: Consider replacing 'microbial mediated reaction' with 'microbially mediated reaction' or 'reaction mediated by microbes'. 5. 16533-6: Consider replacing 'new available electron donor' with 'newly available electron acceptor'. 6. 16533-7: Replace (vi) with (iv). 7. 16533-18: Consider replacing 'microbial available sulphides' with 'microbially available sulphides' or 'sulphides available to microbes'. 8. 16533-18: Replace 'Intense' with 'Intensive'. 9. 16534-7: Replace 'as' with 'than'. 10. 16534-20: Replace 'Soilinst' with 'Solinst'. 11. 16535-9: Replace '4' with 'Four'. 12. 16536-27: Replace 'form' with 'from'. 13. 16537-14: Consider replacing 'soil surface' with 'ground surface'. 14. 16540-17 and 16540-20: Replace 'Ba2+' with 'Ba²⁺'. 15. 16540-18: Replace 'BaSO4²⁻', with 'BaSO₄'. 16. 16547-4: Consider replacing 'The goodness of fit. . .' by 'The correlation coefficient (R) and the average ratio. . . are used to evaluate the goodness of fit of the regression models.' 17. 16547-14: Replace 'and', with 'to'. 18. 16547-8: Replace 'jet', with 'yet'. 19. 16547-25: Consider replacing 'the aquifer material was already. . .' with 'the aquifer material had already been in contact with NO₃⁻ bearing groundwater in situ prior to the push-pull tests' 20. 16552-9: Replace 'new', with 'newly'. 21. 16552-11 to 13 and 16553-6 to 10: there is inconsistent use of 'reduced' and 'reactive'. Please decide on one term and use it consistently. 22. Table 1: Replace 'filer', with 'filter'. 23. Figure 6: Replace 'testet', with 'investigated'.

Interactive comment on Biogeosciences Discuss., 11, 16527, 2014.