Predicting long-term denitrification capacity of sandy aquifers from incubation experiments and sediment properties by W. Eschenbach and R. Well.

This paper addresses relevant scientific questions within the scope of Biogeosciences. It includes a rather large data set and analysis that should be helpful to the scientific community on aquifer denitrification. However, I have several comments and concerns:

1. In the first three pages I noted two apparent typographical errors. On line 11 of the abstract it indicates that the "long-term" denitrification capacities ranged from 0.18. . . However, in Table S2 it appears that this lower range value should be 0.19. Furthermore on page 8810, line 10 "amphiboles" is misspelled as "amphibols." I encourage the authors to review the manuscript again for errors.
2. The stated goals of the research included (page 8811, line 28) "to quantify exhaustibility of long-term denitrification capacity in aquifers." What is "long-term" in the authors' view? As mentioned above, long-term seems to be until the denitrification capacities of the sediments are exhausted. This idea is repeated in the paragraph beginning on page 8811, line 16. However, "long-term" from the methodology seems to mean 1 year incubation experiments [page 8812, line 4; page 8814, line 14; D_{cap} is the "cumulative amount of denitrification. . . at the end of one year of incubation (page 8817, line 26 and following)]. Assuming that using data from incubating sediment samples for one year will result in reliable estimates for minimum lifetimes of denitrification (page 8818, line 21 and following) of up to 66.5 years (Table S2) is a big assumption. In my view, "long-term" from the perspective of aquifer denitrification needs to be > 10 years. Again, I think the data provided are helpful, but the assumptions made and the related limitations of this research need to be more clearly stated. How do we know that all of the organic C and sulphur present in the sediments is able to be oxidized? In sediments I am familiar with, we have organic C in the unsaturated zone (below the soil zone), but little to no pyrite. Knowing that both organic C and pyrite exist below the water table suggests that the organic C above the water table is resistant to oxidation. Could it be that organic C below the water table is also resistant to oxidation?
3. With the comments of #2 above, I recommend that the title be changed to "Predicting long-term denitrification capacity of sandy aquifers from shorter-term incubation experiments and sediment properties.
4. Sulphur was measured as total S (page 8815, line 20) and assumed to be pyrite (page 8818, line 11). Is this a good assumption? On line 6 on this same page it mentions that the possible sulfate produced by dissolution of sulfate minerals was accounted for, but were the amounts significant? Why not measure inorganic S instead of total S?
5. In section 3.6.1 (page 8824), the authors noted that D_{cap} was not predictable by the seven-day denitrification rate (except for non-sulphidic samples) (see also page 8832,

line 11 and following); however, D_{cap} was predicted well with the eighty-four-day denitrification rate. If goal c (page 8812, line 1 and following) is to use push-pull tests to check "long-term" denitrification this presents a problem because push-pull tests generally cannot be used for 84 days?

6. On page 8828 (line 8 and following) the authors write, "The ultimate goal of our research is to predict long-term denitrification capacity (D_{cap}) from initial denitrification rates." But this assumes that a one-year long D_{cap} effectively predicts "long-term" denitrification capacity (as in quantifying its exhaustibility).
7. The questions discussed in section 4.5 (page 8840, line 4 and following) are very good. However, I don't find compelling the authors' responses. The only way I know to adequately answer these questions is to have in situ studies. And push-pull tests apparently won't help achieve the authors' goal (see my comment 5 above). Apparently, the only long-term in situ tests that would work appear to be like those described by Korom et al. (2005). They could be used to test in situ some estimated minimal lifetime of denitrification values given on Table S2 (2-5+ years). They also may help determine what electron donors take part in the denitrification and for how long.