Biogeosciences Discuss.,
doi:10.5194/bg-2016-530-RC1, 2017

Biogeosciences Discussions
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Interactive comment on "Does denitrification occur within porous carbonate sand grains?" *by* Perran L. M. Cook et al.

Anonymous Referee #1

Received and published: 2 February 2017

The manuscript by Cook et al discusses, based on flow-through reactor experiments, the possibilities for denitrification in porous sand grains, which may possibly act as oxygen depleted microniches thus providing an environment for oxygen-sensitive denitrification. The authors, however, conclude that there is no evidence for the existence of those microniches based on the oxygen sensitivity and the absence of diffusion limitation for nitrate. Given the current microniche-focus in N cycle research, Cook et al. add an interesting piece of work which should be available to the readers of Biogeosciences. To me the manuscript is overall very interesting, nicely structured and focused to the point. I have several comments listed in the following which I believe have to be addressed to make it clearer to the reader:

General comments:

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1. Denitrification is defined, in the beginning, however, other N cycle processes are not mentioned in this context (anammox, DNRA), although the methods part basically describes that at least anammox-derived N2 would have been measurable. Both of them would in principle be able to occur under similar conditions.

2. To me, the fact that denitrification occurs already at 10μM O2 is rather an indication that there is indeed a bit of an effect on the process. 10μM O2 is pretty high for measurable rates of N2 production. Dalsgaard et al (2014) actually showed that minimal changes in O2 can largely impact on denitrification rates

3. I would like to see more of a discussion of what this means globally, are there many sediments like this which were suspected to be sites of intense N loss? This basically requires to make a stronger statement on your results. In this context, those grains may not act as microniches for denitrification, however, there may be tipping points e.g. if the organic carbon source increases by eutrophication where indeed this changes. What I think of is that maybe they are just not microniches, yet.

T Dalsgaard et al., Oxygen at Nanomolar Levels Reversibly Suppresses Process Rates and Gene Expression in Anammox and Denitrification in the Oxygen Minimum Zone off Northern Chile mBio 5 (6), e01966-14, 2014.

Specific comments:

Throughout the text: Please check, whether abbreviations are spelled out when mentioned the first time, please unify O2/ oxygen, please check units (sometimes it says uM instead of μM)

p. 2, l18: Please clarify, which process rates.

l. 20: I disagree on that statement, 10μM are pretty high for full denitrification.

L23, Please remove 'rates' after denitrification.

l. 23: I am missing a sentence on the meaning of the result, here.

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l. 31: This effect could be positive or negative, could you elaborate a bit more?

l. 36 Insert ‘under’ after ‘place’.

p. 3, l 57: Where does this number (50μM) come from?

l. 70 ff: I would like to see a map with the sampling locations. Also, for all companies, a location should be added.

l.95: This also changes the CO2 content and with that the pH, what could be the impact?

l. 117: This sentence is odd, please rephrase

l. 163: This doesn’t necessarily have to happen, it may be that denitrification occurs in a range where it wouldn’t occur without porous grains.

l. 184: The fact that the anoxic zone is reduced doesn’t necessarily translate into lower denitrification in a case where substrate supply is higher. It may actually well be that at the oxycline a zone of intense denitrification forms.

l. 190: remove ‘rates’

l.201: Does this make sense in your sediments in terms of light penetration depths?

l. 216: Could also be over-estimating- could you add a reference so that it gets clear what you are talking about, here?

I wish the conclusion could end with a stronger statement on the meaning of your results.

Interactive comment on Biogeosciences Discuss., doi:10.5194/bg-2016-530, 2016.

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