Review of Valiente et al for BGS

The authors aim to determine rates of denitrification, anammox and DNRA in sediments of a shallow saline lake heavily impacted by anthropogenic N inputs. The study aims to investigate the impact of light and/or oxygen conditions on the balance between nitrate reduction processes. This is one of the few studies which have been able to use the 'new' IPT methods accounting for the co-ocurrence of the three nitrate reducing processes which is to the authors' merit. Indeed the authors demonstrate the importance of coupled DNRA-anammox in the sediments and how anammox would be underestimated through $30N_2$ production. However, in order to accept the manuscript it needs a major revision of structure in all sections, streamlining of the text, review of data/figures and thorough proof-reading before resubmission.

Major general comments:

As above, please re-consider the structure of how each section is approached and should be proof-read. I also suggest it's less confusing to keep Results and discussion as separate sections.

Check nitrate/NO_3^- nitrite/NO_2^- throughout for consistency

Consider the relevance of references you use… some are from water column (e.g. Jensen et al 2011) or sediment with very difference settings.

Title: Add in 'sediment' somewhere

Introduction

The introduction is quite disjointed with no logical direction to draw the reader in. For future potential submissions I would suggest a nicer structure to introduce the reader to your topic – e.g.:

- Shortly introduce N cycle and identify large anthropogenic impacts
- Overview on N cycling processes **in sediments**, focus on nitrate reducing processes/end products
- Introduce saline lakes and their importance/why are they interesting/understudied
    - Potential factors controlling NO3- reducing processes in this lake (light, O2 etc)

(I should say that I didn't realise the study was only on sediments until line 80 as this in not explicitly mentioned before. Additionally, Jensen et al 2011 is a water column study so might not be relevant to sediments (where there should anyway be plenty of NH4+)).

Methods

Please re-think the structure and need for the amount of text here

A lot of the text in the Methods section is unnecessary. If you are referencing a method from another paper, it should only be very briefly described in your methods (e.g. a lot of things don't need to be reiterated from Salk et al).

What is the relevance of the treatments to your study site? Does the lake become stratified/anoxic in some months? What is the phytobenthos? Diatoms? Bacterial mats? This needs to be put into context with better descriptions of your site (in methods and results)

Section 2.1:What depth were water samples taken?

Nutrient samples should be filtered (at least 0.2, possibly 0.45um filters) so no nutrients are produced/consumed between sampling/measuring.

Welti et al use a reservoir to feed the sealed (gas-space-free) mesocosms, I'm very confused about the method description here, was the mesocosm water itself bubbled?

Section 2.2:

The first paragraph is a very long way to write 'the overlying water of each mesocosm was bubbled with either air (oxic treatment) or Argon (anoxic treatment)

Why do you seal mescosms with no air space if you're going to bubble them anyway?

Line 135: what do you mean by pump? Do you mean a wheel/stirrer to mix the water to avoid stagnation? If not please explain more clearly – and add how the mesocosm water was mixed.

Was light intensity monitored/measured?

It's fine to use Dalsgaard et al 2000 for timing calculations and assuming 1mm oxygen penetration. However an oxygen penetration depth of 1mm is not correct for the anoxic treatments.

Why was this very high resolution time series chosen? More reasoning should be presented behind this as it seems a bit unnecessary. What is the relevance of 24h anoxia and darkness in a 2m deep lake? Diel and seasonal conditions should be better described in terms of biogeochemistry and phytopenthos etc.

Was water removed though sampling the mesocosms replaced? Were dilution effects accounted for?

In the anoxic treatment why do you assume all NO_3^- reduction takes place in the sediment? Why not also the water column?

Line 164-165: Is this the name of the site? This has not been introduced/mentioned until now.

Section 2.4: A lot of this text is unnecessary and can be streamlined.

Line 181: Use original references for the microdiffusion method.

Results and Discussion (I suggest it's better to split into two sections)

This section is very confusing to read so please consider re-structuring. All of 3.1 seems to be results and 3.2 onwards is a mixture of results/discussion.

It's also important to include the *in situ* conditions you measured and a description of the site. What is the relevance of a longer anoxic incubation to your site?

What are the subscript numbers? E.g. OL_{72}, $t_{(2)}$, $F_{(2,6)}$

Don't forget units (e.g. lines 262-270)

In general, a more thorough discussion of data is needed.

The 'stages' 1, 2 and 3 have not been defined/introduced until the results, please re-consider how you refer to the experiments.

Why is there already so much 15N-N_2 at the time when the tracer is added (in Fig 2)? I suggest the data and zero/background correction is checked. There is something wrong here.

Lines 331-312: "…the experiment would only have underestimated N_2 production processes…" – surely these are two of the three processes you are investigating?!

Figs/tables

There seems to be some overlap/repetition between figures, please try and summarise data in fewer figures.

Keep colours consistent for N species between figures (i.e. NO_3^- appears in red, blue, yellow)

Why is there already so much 15N-N_2 at the time when the tracer is added (e.g. Fig 2)? I suggest the data and zero/background correction is checked. There is something wrong here.

Are both fig 3 and 6 necessary as they are quite similar? Comparing them it seems like there is much more N_2O-denit and DNRA but hardly any N_2-denit in fig 6 than is shown in Fig 3's 15N recovery. Perhaps you can double check:

$^{29}N_2 = 1 \times {}^{15}N$,

$^{30}N_2 = 2 \times {}^{15}N$,

$^{45}N_2O = 1 \times {}^{15}N$

$^{46}N_2O = 2 \times {}^{15}N$

Is Table 1 necessary as it is just copied from Salk et al?