

## ***Interactive comment on “Anammox, denitrification and fixed-nitrogen removal in sediments of the Lower St. Lawrence Estuary” by S. A. Crowe et al.***

**Anonymous Referee #2**

Received and published: 17 February 2012

General comments: The nitrogen cycle seems to get more complex every time I read another paper. And it's no wonder given all the thermodynamically-favorable reactions that can potentially occur in nature and the remarkable ability of microbes to evolve new ways of making a better living through chemistry. But, just because a biochemical reaction is possible does not mean it actually occurs in nature or plays a significant role in the nitrogen cycle. Crowe et al. address the important question of which reactions really matter in the sedimentary nitrogen cycle of the St. Lawrence Estuary. They approach this problem by inoculating sediments with stable isotopes of N in both slurry and whole-core incubation experiments. More specifically, the authors examined the relative importance of nitrification, denitrification, anammox, dissimilatory nitrate reduction, and ammonium oxidation by Mn(III, IV) and Fe (III), and organically-complexed Mn(III) in sediments from one station in the St Lawrence Estuary. The authors found

C5808

relatively modest rates of denitrification, that most of the nitrate fueling denitrification was produced by nitrification, that two-thirds of the N<sub>2</sub> was produced by the "classical" denitrification mechanism whereas the remainder was produced by anammox, and that the other processes they examined were relatively unimportant. Overall, the paper was well written and I appreciated the detailed description of the methodology. The results mostly confirm what other researchers have found, that coupled nitrification-denitrification is important and that anammox contributes significantly to N<sub>2</sub> gas production. The more novel N-pathways examined appeared to be of minor importance, which is an important finding. I have just two comments that I would like the authors to consider.

Specific comments: First, it is a stretch to draw conclusions about the N-cycle of the St. Lawrence Estuary using data from one station. Thus, although these results are important for improving understanding of the N cycle, I think the authors should restrict the scope of interpretation to this one particular location.

Second, the slurry experiment showed little NH<sub>4</sub><sup>+</sup> oxidation by Mn and Fe (hydr)oxides. However, it is not clear whether this result is due to experimental conditions or if this type of anaerobic ammonium oxidation is in fact not occurring at the station. It is well known that even a brief exposure to sulfides in slurry experiments inhibits ammonium oxidation to NO<sub>x</sub>. Although this phenomenon is usually interpreted as inhibition of nitrification (aerobic ammonium oxidation), it is unknown whether sulfide also inhibits ammonium oxidation by Mn and Fe (hydr)oxides. Thus, I interpret these findings with caution. Sulfide concentrations in the slurry experiments were not reported, but would have likely accumulated during the 12h pre-equilibration period and would be consistent with the lack of nitrification observed. I would not be surprised if microbes can carry out these thermodynamically-favorable reactions under the right conditions. At this point, we still don't know.