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Interactive comment on "Icehouse-greenhouse variations in marine denitrification" *by* T. J. Algeo et al.

Anonymous Referee #2

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Review of "Icehouse-greenhouse variations in marine denitrification"

This Is an interesting and potentially important manuscript. Although, as the authors acknowledge, there are many potential pitfalls, the goal of trying to understand the marine nitrogen isotopic signal through Earth's history is an important one. In many ways I think they have done as good a job as is reasonable. However there are a couple of areas that need addressing, and that would make this a more complete work. The first, and potentially most important one, is that they neglect the impact of variations in nitrogen fixation by cyanobacteria in the role of isotopic variations. The isotopic composition of marine fixed nitrogen is set by both losses AND inputs. The model they use considers only isotopic variations in losses. I realize this is a very underconstrained system, but there are good reasons to consider source variations- N fixation mainly takes place

in tropical to temperate waters (thus icehouse conditions might sharply curtail this input of "light N"). They are also prevalent in smaller seas and basins in the modern world (example Mediterranean Sea) and this might be expected to be important in the semi-enclosed basins found in earlier times. The manuscript should consider this in some detail. As it stands it is brushed off in favor of ammonium fractionation effects. Second, I don't know how practical or possible this is, but a graph of the area of continental shelves over time would be potentially very interesting. The timescales involved in this study are vast, and there may have been significant variations in the extent of shelves during this period. One has to be careful with the ammonium uptake fractionation issue. Uptake fractionation is only relevant if incomplete uptake is taking place. In general, unless one is an upwelling zone, uptake fractionation is not considered important. I think they do a good job with the issue of the differing sedimentary environments (coastal vs open ocean) but it still is a concern. The highest values they report are those from shelf environments, and we know these are susceptible to recording enhanced local signals from water column denitrification in modern environments (Arabian Sea, for example). Likewise, the lightest records are from inland seas that appear to be heavily influenced by terrestrial OM (based on carbon isotopes). One has to work with the cores that are available, but these are significant problems.

One thing- they might choose a different set of example compounds to discuss digenetic effects for N (page 4). Neither lignin loss nor lipid retention will affect N isotopes of the remaining OM, as neither has any N to lose or fractionate.

Interactive comment on Biogeosciences Discuss., 10, 14769, 2013.