Fe^{2+} and H_2S as electron donors during benthic N transformations in anoxic lake sediments

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Microorganisms help to mitigate N-loading in lakes by eliminating reactive N through anaerobic N_2 production via denitrification and/or anammox. In contrast, dissimilatory NO_3^- reduction to ammonium (DNRA) retains bioavailable N within the system, promoting internal eutrophication. Fe^{2+} and H_2S are thought to serve as potential alternative electron donors during benthic N cycling, but experimental evidence is still rare. Conducting incubation experiments with benthic microbial biomass and ^{15}N label compounds (e.g. NO_3^- and NO_2^-) we investigated the Fe^{2+} and H_2S control on denitrification and DNRA at two sites in Swiss Lake Lugano (Figino (Fe-rich) and Melide), where anammox contribution to N removal was generally <1%. We saw clear evidence for a substantial Fe control on the balance between denitrification and DNRA. In the NO_3^--amended treatments (and less so in the NO_2^- treatments), we observed Fe-stimulation of DNRA at the cost of denitrification, suggesting coupling of DNRA to Fe oxidation mostly at the NO_3^--reduction step. The Fe^{2+} control was differential at the two sites, suggesting significant intra-basin variability in the benthic microbial communities. Similarly, H_2S addition had different impact at the two sites. At Melide, in contast to Figino, additional H_2S considerably enhanced both benthic denitrification and DNRA, indicating locally significant contribution by chemolithotrophic bacteria to total benthic nitrate reduction.