Stable isotope approaches to characterizing anammox and associated microbial processes in engineered and environmental systems

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As one of the most important processes for the removal of fixed nitrogen, anammox is an essential component of the nitrogen cycle, but its role in various environmental settings remains incompletely understood. One source of complexity is that anammox is also inextricably tied to other N cycle pathways. This complexity provides both challenges and opportunities for the application of stable isotope measurements to identify the role of anammox in various natural settings. We perform experiments monitored by ^{15}N and ^{18}O measurements of nitrite, nitrate, and ammonium in the anammox stage of a wastewater treatment system to (1) better characterize the isotopic fractionation factors associated with anammox, (2) reveal the isotopic effects of coupling anammox to various other N-cycling processes, and (3) determine in turn how best to use stable isotope measurements to distinguish among different processes in the system. Preliminary data demonstrate that these isotopic measurements are a useful tool for distinguishing among processes in the system. The isotope effect $^{15}\varepsilon$ for the consumption of ammonium ranges from 21.4 to 30.9‰ under various environmental conditions, while isotope effects for the removal of nitrite have varied systematically through the history of the system. These results can all be applied to the goal of understanding how anammox imprints itself on stable isotopic systematics in a wide range of environmental settings.