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Cryptic or day-to-day parts of the riverbed N cycle – new challenges for ^{15}N

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The discovery of anaerobic ammonium oxidation (anammox) not only changed our understanding of the nitrogen cycle in aquatic ecosystems but it also undermined some of the key ^{15}N techniques used to study it. Reformulations of principle equations and the development of new $^{15}N_2$ and $^{15}N_2O$ techniques enabled the simultaneous quantification of N_2 production by anammox and denitrification in mainly soft, cohesive sediments where redox gradients are clearly defined and solute exchanged governed by diffusion. At the heart of the application of ^{15}N, for the quantification of natural ^{14}N cycling, is the key assumption that the respective pools of ^{15}N and ^{14}N are evenly mixed and that both are cycled without bias towards each other. Recent evidence, however, from a variety of aquatic ecosystems, suggests that this may not be the case. For example, organic N may be oxidised directly to N_2 gas without ever mixing with the inorganic pool or inorganic intermediates (e.g. nitrite) are 'shunted' internally and also fail to mix evenly with the applied tracer pool. Our most recent work in permeable, oxic gravel riverbeds presents some particular challenges to the application of ^{15}N. In these systems, a tight coupling between aerobic nitrification and anaerobic N_2 production – in the presence of 100