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Organo-mineral complexation alters carbon and nitrogen cycling in stream microbial assemblages

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Inland waters are of global biogeochemical importance receiving carbon inputs of ~ 4.8 Pg C y^{-1}. Of this 12 % is buried, 18 % transported to the oceans, and 70 % supports aquatic secondary production. However, the mechanisms that determine the fate of organic matter (OM) in these systems are poorly defined. One important aspect is the formation of organo-mineral complexes in aquatic systems and their potential as a route for OM transport and burial vs. microbial utilization as organic carbon (C) and nitrogen (N) sources. Organo-mineral particles form by sorption of dissolved OM to freshly eroded mineral surfaces and may contribute to ecosystem-scale particulate OM fluxes. We tested the availability of mineral-sorbed OM as a C & N source for streamwater microbial assemblages and streambed biofilms. Organo-mineral particles were constructed *in vitro* by sorption of ^{13}C:^{15}N-labelled amino acids to hydrated kaolin particles, and microbial degradation of these particles compared with equivalent doses of ^{13}C:^{15}N-labelled free amino acids. Experiments were conducted in 120 ml mesocosms over 7 days using biofilms and streamwater sampled from the Oberer Seebach stream (Austria), tracing assimilation and mineralization of ^{13}C and ^{15}N labels from mineral-sorbed and dissolved amino acids.

Here we present data on the effects of organo-mineral sorption upon amino acid mineralization and its C:N stoichiometry. Organo-mineral sorption had a significant effect upon microbial activity, restricting C and N mineralization by both the biofilm and streamwater treatments. Distinct differences in community response were observed, with both dissolved and mineral-stabilized amino acids playing an enhanced role in the metabolism of the streamwater microbial community. Mineral-sorption of amino acids differentially affected C & N mineralization and reduced the C:N ratio of the dissolved amino acid pool. The present study demonstrates that organo-mineral complexes restrict microbial degradation of OM and may, consequently, alter the carbon and nitrogen cycling dynamics within aquatic ecosystems.