Archaeal Ammonia Oxidisers in Soil: So What?

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Soil nitrification, the oxidation of ammonia to nitrate, via nitrite, is central to the terrestrial nitrogen cycle. It is important for plant nitrogen nutrition and has considerable and environmental impact, increasing loss of ammonia-based fertiliser, polluting groundwater with nitrate and generating the greenhouse gas nitrous oxide. Until recently, the first step in nitrification, ammonia oxidation, was thought to be dominated by autotrophic bacteria. The discovery of autotrophic ammonia oxidising thaumarchaea and the presence of thaumarchaeal functional (*amoA*) genes in soil has led to a reassessment of soil ammonia oxidation and oxidisers and begs the question: so what? Do both bacterial and archaeal ammonia oxidisers contribute significantly to nitrification in soil; do they occupy distinct niches, such that contributions differ between soil physicochemical and biological characteristics; if so, do different niches reflect fundamental differences in phenotype; would extinction of either group matter?

Data on the abundance and sequence composition of bacterial and thaumarchaeal *amoA* genes suggest some differences in relative activities and niche-selection between and within bacterial and thaumarchaeal ammonia oxidisers. Lack of representative cultivated strains severely limits attempts to explain such differences in terms of phenotype. Soil microcosm experiments have, however, provided the environmental control and monitoring necessary for targeted experiments testing potential mechanisms driving activity and diversity. This approach, combined with data from biogeographical and cultivation-based studies, provides information which suggests at least two important situations in which differences in the activities of bacteria and thaumarchaeal ammonia oxidisers are crucial for ecosystem function, with considerable potential economic and environmental impact.