

New Key Organisms in the Nitrogen Cycle

Institute of Soil Ecology

Ammonium oxidation is the first step in nitrification, a key step in the global nitrogen cycle which leads to the formation of nitrate. Nitrate is an essential nutritional element for plants. However when nitrate is leached from the soil it can lead to contamination of groundwater, particularly if it is present in high concentrations, which are not used by the plant. Therefore the kinetic of nitrate formation is of great importance.

Until now it was thought that Gram negative bacteria (proteobacteria) are mainly responsible for the ammonium oxidation. Scientists from the GSF Institute of Soil Ecology, working with other international research groups, have successfully identified microorganisms belonging to Archaea as key organisms in this process. These organisms build their own domain in the phylogenetic tree of life besides Bacteria and Eukarya.

As until now none of these organisms has been cultured from soil, molecular and biomarker approaches were used to show the importance of this group of organisms for the transformation of ammonium. It could be shown that in soils from different climatic zones ammonium oxidizing archaea were

more abundant compared to the functional redundant group of ammonium oxidizing proteobacteria and that the appropriate metabolic pathway for ammonium oxidation is induced. Thus archaea, more precise crenarchaeota, are clearly the most common ammonium oxidisers in the global soil system and make a considerably higher contribution to nitrate formation than their bacterial counterparts.

These new findings are very important for agricultural practice, as now it will be possible to look for ways to stimulate the activity of these archaea using targeted agricultural management techniques. In this way the application of nitrate fertilisers could be reduced, and with it the resulting potential environmental impact.



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Literature:

■ Leininger, S. et al.:
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