Geophysical Research Abstracts
Vol. 14, EGU2012-12995-1, 2012
EGU General Assembly 2012

Testing Silver Nanoparticle Toxicity Using the Ammonia Oxidizing Bacteria Nitrosomonas Europaea and a High-throughput Assay

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Understanding the toxicity of nanoparticles on ecologically significant wastewater microbiota, specifically ammonia oxidizing bacteria (AOB), is critical due to the exponential increase in commercialization of nanoparticles as well as the sensitivity of AOB to inhibitors. A high-throughput activity assay was developed to rapidly screen for nanoparticle toxicity on AOB, using a multi-well plate method and AOB Nitrosomonas Europaea. This method demonstrated good agreement with previously established batch bottle assays utilizing both silver ions (Ag+) and nanoparticles (Ag-NPs) as nitrification inhibitors. The method was used to study the inhibition of Ag+ and Ag-NPs (20 nm) on the nitrification by N. Europaea cells grown in fill-and-draw reactors compared exponentially grown batch cells. Results indicate longer hydraulic residence times increased some protection against inhibition as measured by the production of nitrite over a three hour assay. The cells were more sensitive to Ag+ than Ag-NP, which is consistent with our past observations. Studies are currently being conducted to determine the effects that the presence of humic acid and cations on the inhibition and toxicity. Our initial results show that the presence of Mg++ provides protect from Ag-NP inhibition, which partly results from the aggregation of the Ag-NP and a decrease in the rate of oxidation of the Ag-NP to Ag+. The presence of humic acid also provides for some protection from Ag-NP inhibition.