Poster #XXX

Ammonia-Oxidizing Archaea are the Dominate Nitrifiers in Two Midwestern (USA) Forest Types, But Do Not Contribute to Nitric Oxide Production

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In terrestrial ecosystems, nitrification plays a crucial role in regulating the overall abundance of oxidized inorganic nitrogen and is responsible for initiating the subsequent loss of soil nitrogen (N) via volatilization and leaching. Gross production of nitrate (NO_3^-) is limited by ammonia-oxidation, which is defined as the microbiological oxidation of ammonia (NH_3) to nitrite (NO_2^-)via intermediates. This process is mediated by both ammonia-oxidizing archaea (AOA) and bacteria (AOB). In many soils, AOA greatly outnumber AOB indicating their potential importance to rates of nitrification, especially in acidic soils where AOA tend to dominate. Gaseous by-products of ammonia-oxidation include nitric oxide (NO), which, if not consumed by other processes, can be released from the soil and contribute to the greenhouse effect. In this study, we evaluated the abundance and N-cycle activity of AOA and AOB in two different mixed hardwood stand-types typically found throughout the Midwestern USA. Stand-type differentiation was based on whether plots were either dominated by trees that associate with arbuscular mycorrhizal fungi (AM) or ectomycorrhizal fungi (ECM). In general, AM plots possessed more labile litter and higher rates of net nitrification. Both stand-types possessed acid soil; however, ECM soil was more acidic. The abundance of AOA and AOB, based on qPCR assays, illustrated that AOA were roughly 2X more abundant than AOB in AM stands and 5X more abundant in ECM stands. We used an inhibitor-based nitrification assay (1-octyne) to determine that in AM soil, AOA contributed 80% to the net production of NO_3. Additionally ECM stands showed no observable net nitrification; however, the addition of a known total-nitrification inhibitor (acetylene) resulted in accumulation of NH_3, which was equivalent to the AM stands, indicating that ammonia oxidization was occurring in ECM stands. Nitrification-derived nitric oxide (NO) flux was measured from soil using an aerobic continuous-flow soil incubation system connected to a chemiluminescence detector. Soil from AM stands produced significantly more NO relative to the ECM stands. The application of nitrification inhibitors indicated that AOA did not contribute to the efflux of NO, which may be a function of their utilization of NO as a nitrification intermediate. This work illustrates that (1) AOA may be the dominant ammonia-oxidizing taxa in Midwestern mixed-hardwood forest soils, (2) AM and ECM stands are functionally different in the production of NO, and (3) AOA do not contribute to NO fluxes from soil, indicating a stark difference from functionally similar microbes, AOB.