Trace N gas losses and N mineralization I Mojave desert soils exposed to elevated CO₂

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Abstract We examined N cycling processes in desert soils exposed to elevated CO₂ to better understand how some features of aridland soil N and C cycling may respond to an altered atmospheric composition. We measured rates of denitrification, potential denitrification, N₂O fluxes, NH₃ volatilization, and net mineralization in an intact Mojave Desert ecosystem with elevated CO₂ (Free Air Carbon Enrichment technology) over 2 years. All measurements were performed on soil under four different cover types: Larrea tridentata; Lyceum spp.; Pleuraphis rigida; and plant interspaces. The mean rate of denitrification was 161 ± 96 μG N m⁻² d⁻¹. Field fluxes of N₂O occurred sporadically, with a mean of 30 ± 20 μG N m⁻² d⁻¹. Rates of NH₃ volatilization experienced less variability than did N₂O fluxes, with a mean of 120 ± 45 μG N m⁻² d⁻¹. Mean potential denitrification enzyme activity (DEA) was 146 ± 8 mg N m⁻² d⁻¹. Rates of net mineralization were highest in soil under L. tridentata and Lyceum spp. (398 ± 108 mg N m⁻² d⁻¹) and lowest in the plant interspaces (129 ± 28 mg N m⁻² d⁻¹). There was no effect of elevated CO₂ on N₂O fluxes or mineralization rates. There was a 39% increase in NH₃ volatilization with elevated CO₂ during March 2000. Potential DEA increased by 193% with elevated CO₂ in October 1999 and decreased by 45% in March 2001. These results suggest that NH₃ volatilization may be a more important component of aridland gaseous N emissions than previously thought, and that the potential for high DEA does not necessarily induce large fluxes of N₂O under natural conditions, especially in aridlands where rainfall primarily occurs in winter when soil temperatures can limit microbial activity. This study also suggests that the effects of elevated CO₂ on soil microbial activity may not be consistent for all seasons.