Occurrence of Nitrous Oxide in the Central High Plains Aquifer

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The Central High Plains aquifer underlies an area of about 124,000 km^2 in parts of five states. Concentrations of nitrous oxide in water samples collected from the Central High Plains aquifer in 1999 ranged from < 1 to 940 nM, with a median concentration of 29 nM (n=123). Eighty percent of the nitrous oxide concentrations exceeded the aqueous concentrations expected from equilibration with the atmosphere. Concentrations of nitrous oxide were significantly ($p<0.001$) larger in recently recharged water than in older water, indicating that concentrations in the aquifer increased over time. Concentrations of nitrate, tritium, and nitrous oxide in the unsaturated zone at one site indicate that the bulk of nitrogen-enriched recharge resided in the thick unsaturated zone. If that finding is generally true for the Central High Plains, nitrous oxide concentrations in the aquifer will continue to increase over time. Large concentrations of oxygen and nitrate, small concentrations of ammonium and dissolved organic carbon, and the lack of excess, nonatmospheric nitrogen gas (the end product of denitrification) in the aquifer indicate that nitrous oxide in the Central High Plains aquifer was produced by nitrification. Mechanisms for nitrous oxide transport from the aquifer to the atmosphere include irrigation pumping, ground-water discharge to streams, and possibly upward diffusion of nitrous oxide through the unsaturated zone.