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Kinetic Parameters characterizing Production and Reduction of nitrous oxide during Denitrification in the saturated Zone

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A significant amount of global emissions of the powerful greenhouse gas nitrous oxide (N_2O) originates from agricultural ecosystems. Indirect emissions arising from groundwaters are also thought to be important, but there are still uncertainties in quantification of these emissions. Another difficulty is the fact that N_2O as an intermediate product from denitrification is permanently influenced by different enzyme kinetics of various denitrifying communities and that emissions are a net result of simultaneously running production and reduction reactions. The objective of this study is to evaluate the kinetic rate constants characterizing these reactions and to compare the results with in situ data from monthly multilevel well measurements. To determine the time course of production and reduction of N_2O during denitrification we conducted a long-term batch experiment: aquifer materials from the saturated zone at different depths of an important drinking water producing area in Northwest Germany were supplemented with $K^{15}NO_3$ solution, incubated as slurries under anaerobic conditions, gas samples were taken at regular intervals and N_2O as well as $^{15}(N_2O{+}N_2)$ concentrations were measured by gas chromatography and mass spectrometry, respectively. Results available up to now indicate a wide range of headspace gas concentrations and consequently a large variability in enzyme activity. Whereas a few samples show an activity which is almost negligible, most of them are characterized by an approximate linear increase of N_2O concentrations up to an extremum which is followed by decreasing N_2O concentrations. Furthermore, there is a distinct connection between gas concentrations and sampling depths: samples which were taken from 250 to 300 cm depths

show significantly higher gas concentrations than these which were taken from 150 to 200 cm depths. This is in agreement with results of former studies which assume favourable conditions for autotrophic denitrification in depths between 300 and 700 cm caused by reduced sulphur compounds as an electron donor. To compare the in situ data with the laboratory results, the kinetic reaction parameters in the field will be derived from measured ground water concentrations of nitrate, nitrous oxide and dinitrogen.