Geophysical Research Abstracts,
Vol. 10, EGU2008-A-05922, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-05922
EGU General Assembly 2008

Emissions of sulfur and greenhouse gases from acid-sulfate soils

O.T. Denmead (1), B.C.T. Macdonald (2), I. White (2), R. Reilly (2), A. Kinsela (3), M.D. Melville (3), D.W.T. Griffith (4) and G. Bryant (4)

(1) CSIRO Land and Water, Canberra, Australia, (2) Fenner Institute of Environment and Society, Australian National University, Canberra, Australia, (3) University of New South Wales, Sydney, Australia, (4) University of Wollongong, Wollongong, Australia

Many Holocene sediments in coastal lowlands were deposited under marine conditions and the soils that were formed contained large amounts of sulfides, principally as pyrite (iron sulfide). When these soils are drained for agriculture or commercial developments, the sulfides oxidise and produce a range of dissolved sulfur species in highly acidic ground water. These soils are often referred to as acid sulfate soils (ASS). Typically, Australian ASS in coastal lowlands have high organic carbon contents, high water tables and low pH. These characteristics suggest that they could emit S gases such as $SO_2$and H_2S, and the greenhouse gases CO_2, CH_4 and N_2O.. In an 8-year program, we have measured emissions of these gases from Australian ASS producing sugar cane, using both chamber and micrometeorological techniques. Over 73 days spread over 4 years, we found substantial emissions of SO_2, averaging 33 gS ha^{-1} d^{-1}. There was a marked diurnal cycle in the emission with maximum rates around noon and virtually no emission over night. Emissions appeared to be driven by evaporation and soil temperature, and it is suggested that SO_2 escapes to the atmosphere through the evaporation of soil water containing sulfite. We estimate that emissions of SO_2 to the atmosphere from ASS could be of the same magnitude as the total emissions of S from terrestrial biogenic sources identified to date, or those from biomass burning. They appear to be around 2% of currently recognised anthropogenic emissions. Emissions of H_2S have been detected but no definitive figures can be given. Our data base for the greenhouse gases is larger and includes a whole-of-growing season

measurement period of 342 days. The emission of CO_2 from the soil over this period amounted to 28t ha^{-1} and contributed 35% of the CO_2 assimilated by the crop. Over the season, there was a net emission of CH_4 that averaged 153 g ha^{-1} d^{-1}, which is 2 to 10% of the rates reported for rice or wetlands. The source may be the many drains in the farming areas. The crop was fertilized with urea at the beginning of the season at a rate of 160 kg N ha^{-1}. Emissions of N_2O over the season were large and sustained, increasing to very high rates after fertilizing and remaining high for 5 months. The average emission rate for the growing season was 134 gN ha^{-1} d^{-1}, which is several times larger than emissions usually reported for other agricultural soils. Just why the emission factor should be so large for ASS is still to be determined. Undoubtedly, the high porosity and high carbon content of the soil coupled with frequent rainfall leading to high soil moisture contents are important drivers, but we are investigating the possibility that N_2O is also formed through processes of chemo-denitrification because of the low soil pH. Alternative pathways through sulfide or ferrous iron have been suggested.