Geophysical Research Abstracts
Vol. 12, EGU2010-5049, 2010
EGU General Assembly 2010

Microbial lipids in Paddy Soils of the Yangtze Area

Cornelia Mueller-Niggemann (1), Andrea Bannert (2), Michael Schloter (2), Zhihong Cao (3), and Lorenz Schwark (1)

(1) Christian-Albrechts-University of Kiel, Germany (cmn@gpi.uni-kiel.de), (2) Institute of Soil Ecology, Helmholtz Zentrum München, German Research Center for Environmental Health, Germany, (3) The Institute of Soil Science, CAS Chinese Academy of Sciences, Nanjing 210008, PR China

Geobiochemical studies of rice paddy soils and their effect on the global carbon cycle are of paramount importance. Paddy soils comprise manmade wetlands because soil flooding is a prerequisite for lowland rice cultivation. Except for sulphate-rich substrates, rice growth is not very sensitive to soil conditions prevailing prior to conversion of marine tidal flat sediments to paddy cultivation. Thus, soil management practices, such as artificial submergence or drainage, ploughing and puddling (i.e. ploughing a submerged soil), manuring, liming, and fertilization, are the major driving factors of paddy soil development.

Soil organic matter (SOM) decomposition and humification proceeds in hydromorphic soils at a slower rate than in well-drained, aerated soils. Rice paddy soils thus also represent a suitable model system to study fundamental aspects of redox sensitive soil processes. These processes are of special interest because in flooded rice fields the anaerobic fermentation of SOM leads to the release of methane and to denitrification losses of inorganic nitrogen.

Here we present results from a chronosequence study of paddy soils with different and well known starting dates of cultivation, in the Zhejiang province (Yangtze River delta) by land reclamation through the building of protective dikes over the past 2000 years. We here describe the biomarker geochemistry of six paddy soils that developed on marine tidal sediments and where cultivation started 50, 100, 300, 700, 1000 or 2000 years before present. As reference substrates recent marine and lacustrine sediments were selected.

The differentiation of the lipid biomass was achieved by investigating glycerol dialkyl glycerol tetraethers (GDGT). These specific organic geochemical biomarkers allow for determining the abundance of fossil microbial consortia (archaea and bacteria input) into paddy soils, justified by the diversity of the archaeal and bacterial cell membrane constituents. The dominant proportion of the GDGT in soils and in the lacustrine sediment derived from bacterial branched isoalkane tetraethers (BIT) as described previously for dry-land soils [1]. Only the marine sediment contained significant amounts of isoprenoidal GDGT originating from eury- and crenarchaeota. This result contradicted our expectation that methanogenic euryarchaeota thriving in paddy soils should lead to high abundances of isoprenoidal GDGT, in particular calarchaeol.

Additionally we compared concentration of isoprenoidal GDGT cell membrane lipids with the number of ammonia monooxygenase gene copies from ammonia-oxidizing archaea and bacteria (AOA and AOB amoA) determinated by phylogenetic analysis. Concentration of the isoprenoidal tetraether lipid crenarchaeol (ng per g of soil) correlated with the abundance of archaeal amoA gene copies (copies per g of soil). This agrees with a dominance of ammonia-oxidizing archaea (AOA) over ammonia-oxidizing bacteria (AOB) in paddy soil nitrification as previously shown for a variety of terrestrial soil types [2].

The distribution patterns of GDGTs revealed that microbial lipids have been converted from marine to paddy signatures within a period of only 50 years.

[1] Weijers J.W.H., et al. (2007) Geochim. Cosmochim. Acta 71, 703–71
[2] Leininger S., et al. (2006) Nature 442, 806-809