Anaerobic nitrogen fixation and an associattion with methanogenesis in wetland ecosystems

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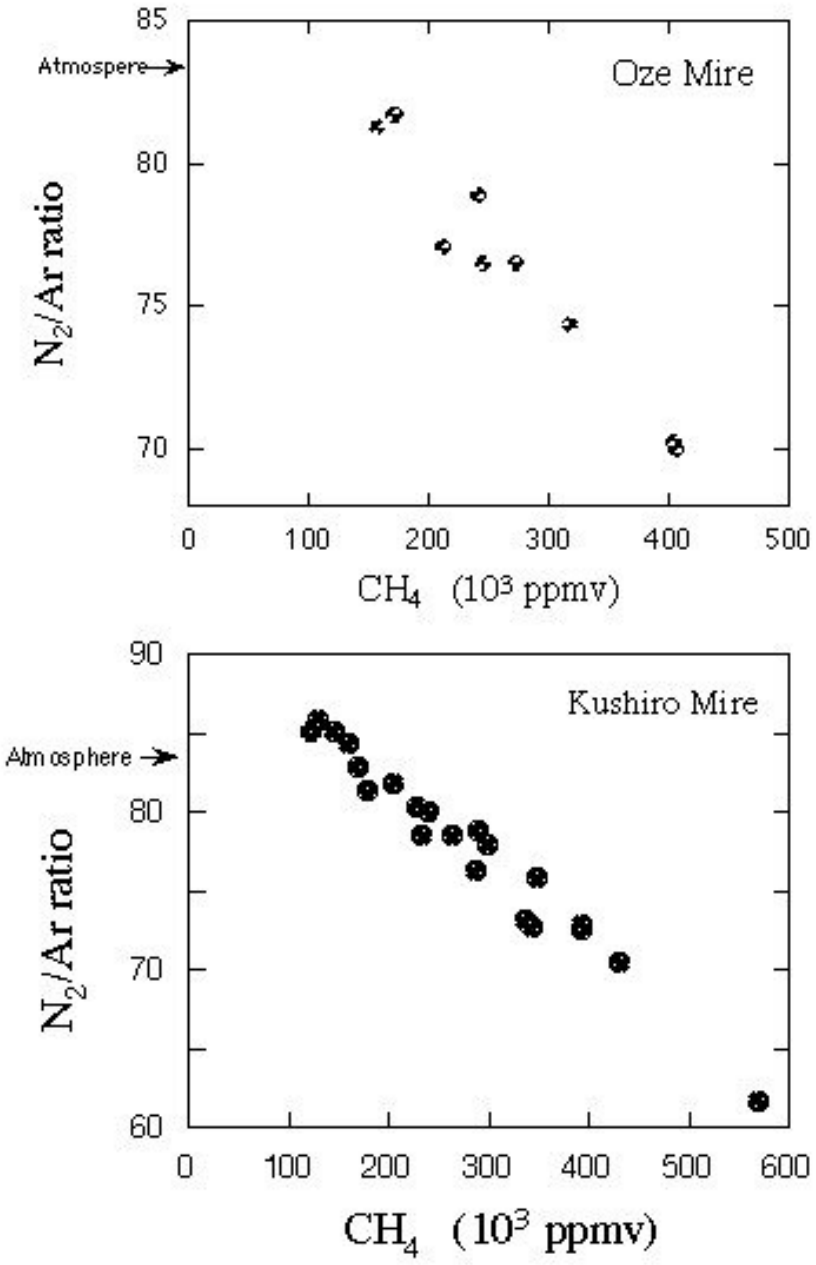
Little knowledge is available about anaerobic nitrogen fixation and its implication for the methanogenesis in wetlands, even though a number of studies have indicated that nitrogen fixation itself is widespread and could be an important source for the nitrogen economy in these ecosystems. Here, the presence of nitrogen fixation in anaerobic peat habitats was evidenced in several ways: 1) a significant decrease in N2/Ar ratio in peat interstitial airs and peat bubbles against the atmospheric value (83.6), suggesting a gaseous N2 removal in ill-ventilated milieus; 2) an increase in delta 15N of N2 in these samples with increasing an apparent N2 consumption; 3) high acetylene reducing activities under completely deoxygenated conditions, which was almost 10-fold larger than the activities under aerobic condition within 0-50 cm depth interval. Precise measurement of interstitial water chemistry revealed quite low inorganic contents at 1 micro molar level or below (except sites under an influence of water inflows), showing an extreme nitrogen-oligotrophy to encourage nitrogen fixation. In two wetlands of different types, apparent N2 consumption was strongly correlated with the bubble CH4 content. Anaerobic habitats rich in organic substrates may allow for both methanogenesis and anaerobic nitrogen fixation, suggesting a forgotten counterflux of the atmospheric N2 associated with CH4 emission from peatland ecosystems.



Relationship between N_2/Ar ratio and CH_4 content in wetland bubble from Oze Mire (upper) and Kushiro Mire (lower)