Supplementary information

1. Possibility of desorption

It has been suggested that CH_4 release from plant materials might result from CH_4 desorption in low-CH_4 environments, e.g., after flushing with CH_4 free air (Kirschbaum et al., 2007).

It has previously been shown by Kirschbaum and Walcroft (2008) that desorption does not play a significant role under ambient conditions of moisture, temperature and CH_4 concentrations (Kirschbaum and Walcroft, 2008). However, whereas Kirschbaum and Walcroft used ambient CH_4 levels for adsorption and investigated the desorption at ambient temperatures under low CH_4 conditions, we also investigated adsorption to peat at much higher CH_4 concentrations of 12,500 ppm, 100 ppm and 10 ppm and its desorption at 50 °C. For each concentration level 6 vials were prepared and left to rest at room temperature for 3 days to allow the CH_4 to adsorb to the peat surfaces. The samples were then divided into two groups, one being lyophilised overnight, then flushed with CH_4 free air, while one was only flushed with CH_4 free air. A third group of three peat samples, which contained no additional CH_4 but were also lyophilised and flushed with CH_4 free air, served as control. Finally, all three groups were supplemented with water and incubated at 50 °C for 17 h.

The objective of this experiment was to determine whether the observed CH_4 emissions were indeed formed during the incubations or were due to an artefact caused by desorption of CH_4, possibly arising from microbial origin, from the material under higher than ambient CH_4 levels in the soil or peat. Moreover, this experiment also enables us to determine if any of the adsorbed CH_4 following the lyophilisation process could account for some of the CH_4 observed in our measurements.

The peat samples treated with the highest CH_4 levels (12,500 ppm) showed an increased CH_4 release in both CH_4 supplemented groups (2.2 ± 0.9 ng g^{-1} (dw) h^{-1} and 3.3 ± 0.3 ng g^{-1} (dw) h^{-1} for samples with and without lyophilisation, respectively) compared to the untreated control group (0.4 ± 0.1 ng g^{-1} (dw) h^{-1}). However, the samples treated with 100 and 10 ppm CH_4

showed no significant increase, both with and without lyophilisation. Furthermore, samples of kaolinite and sea sand were tested for their adsorption potential of CH_4 using 10 ppm CH_4 but again no adsorption/desorption was detected.

2. Exclusion of methane oxidation by methane consuming bacteria

Several experiments from the water dependence study were repeated to investigate the possible influence of methanotrophic bacteria on CH_4 emissions. For the dry samples and those with a sample to water ratio of 2:1, 1:1 and 1:2 the experiment was repeated at 40 °C with the addition of 20 µl diflouromethane (DFM) per vial. DFM was added to inhibit CH_4 oxidation by any methanotrophic bacteria (Miller et al., 1998) possibly present in the non-sterile samples. No significant effect was observed on the emission rates after adding DFM, leading to the conclusion that there were no methanotrophic bacteria active in the lyophilised samples. Measured CH_4 emissions were 0.8 ± 0.2 ng g^{-1} (dw) h^{-1} without DFM and 0.4 ± 0.02 ng g^{-1} (dw) h^{-1} with DFM for the dry samples. The wetted samples showed emissions ranging from 1.6 ± 0.1 to 1.9 ± 0.1 ng g^{-1} (dw) h^{-1} with and without added DFM.

3. Arrhenius plots

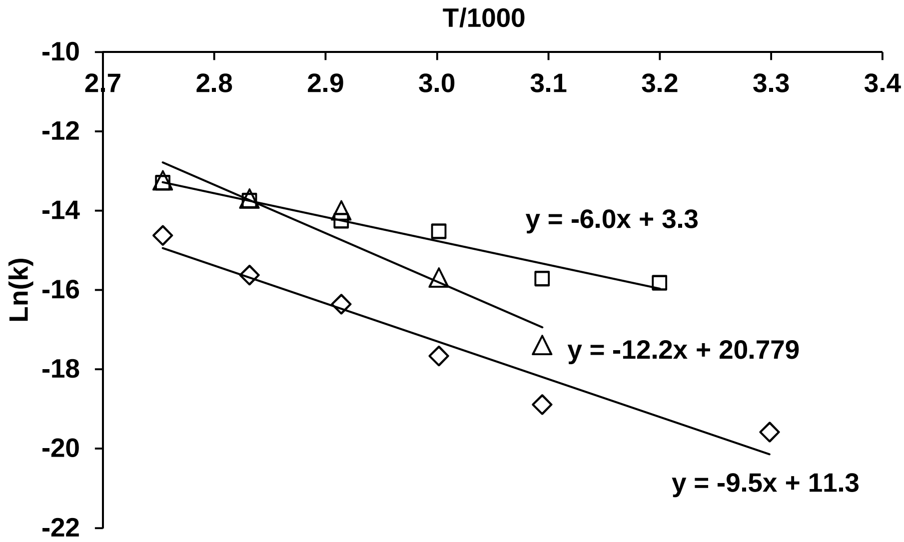

Fig S1: Arrhenius plot for formation of CH_4 in peat PH (◊), soil SL (□) and soil SG (Δ).

We used the experimental data from samples SL, SG and PH to draw Arrhenius plots for CH_4 formation (Fig. S1). For all samples the results were found to follow a linear relationship at temperatures ranging from 30 to 90 °C. The activation energies (E_a) for CH_4 formation for each sample, calculated from the slope of the line, yielded values of 50.1 kJ mol^{-1}, 101.3 kJ mol^{-1} and 79.2 kJ mol^{-1} for SL, SG and PH, respectively. Again, this is strong supportive evidence of an abiotic underlying process as reactions with activation energies higher than 50 kJ mol^{-1} are considered to be abiotic (Schönknecht et al., 2008).

References

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