High rates of N and C mineralization in upper permafrost of a thawing palsa mire and their implications for GHG dynamics

Supplement information

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S1 Materials and methods

S1.1 Study site

In October 2012 peat cores were sampled from the Peera Palsa Mire located southeast of Kilpisjärvi, Northern Finland (68° 89' N, 21° 05´ E) (Figure 1a). The mean annual temperature in the area is –1.9 °C and the mean annual precipitation is 487 mm (1981-2010) (Pirinen et al., 2012). The sampling site is situated in a sub-Arctic sporadic permafrost zone, also described as a palsa zone (Seppälä, 1988, 2006). Peera palsa is raised by frost heave up to ~3 m above the surrounding mire area and shows signs of an early collapsing state (Kohout et al., 2014). Palsas in this area mainly developed between 3000 BP and 1000 BP (Oksanen, 2006; Seppälä, 1988, 2005). The palsa surface on Peera has typical sub-Arctic ombrotrophic permafrost peatland vegetation including dwarf shrubs and herbaceous plants (e.g., *Betula nana* L., *Rubus chamaemorus*, *Empetrum nigrum*) and lichens (e.g., *Cladoniaceae*). Due to frost heave and wind abrasion, parts of the palsa surface are bare of vegetation (Seppälä, 2003). A detailed description of the Peera sampling site including a more detailed vegetation description is given by (Voigt et al., 2017).

S1.1 Sampling of the intact peat cores

The peat cores for this study were sampled from naturally bare peat surfaces on the palsa complex (Figure 1c, d) because of their high N_2O fluxes, which are well-documented by previous

studies(Marushchak et al., 2011; Repo et al., 2009). A detailed description of the peat core sampling site and the sampling procedure is given in (Voigt et al., 2017).

Four intact peat cores with a length of 71–92 cm and a diameter of 10 cm were sampled using a custom-made coring device consisting of a stainless-steel corer with removable cap which was hammered into the ground with a pneumatic drill (Figure S1a-c). The peat cores were collected in polypropylene tubes with a 10 cm diameter. (Figure S1, S2). The peat core profile included the whole active layer plus 15 cm of the upper permafrost. After sampling the peat cores (Figure S1c) were immediately transferred to a domestic freezer adjusted to a mild freezing temperature of –5 °C (±1 °C; SD) by a custom-made temperature control unit.

The peat cores were stored at –5°C (±1 °C) for about five months before the 33-week mesocosm thawing experiment described in detail in previous publications (Voigt et al., 2017, 2019). The intact peat cores chosen for our incubation experiment underwent gradual thawing under a so-called "dry" moisture treatment: the water table was kept at the original level of >50 cm below surface during the whole experiment (designated as DB, dry bare, treatment, see Voigt et al. (2017, 2019)). After we finalized the mesocosm thawing experiment, the peat cores were refrozen to mild freezing temperatures of –5°C (±1 °C; SD) and stored for six months before the start of the incubation experiment presented here.

S1.2 Cutting the intact peat core and preparations

We used for the incubation experiment homogenized peat of five peat layers from four peat cores. Therefore, the full-length peat cores had to be cut into appropriate peat layer lengths. The peat layer dimension was defined by the individual peat core length and active layer depth (Table S1). The intact peat cores were cut using a circular saw while the peat soil was under frozen condition. The cutting was performed at that stage to accomplish a clear, straight cut of the different layers and to avoid a temperature increase and loss of peat soil (Figure S2). Immediately after the cutting, we wrapped the peat layers in a plastic film and transferred them back to mild freezing temperatures (–5 ± 1 °C) for storage. For the incubation experiment, the frozen and cut peat layers were thawed for 48 h to +4 °C (±2 °C).

S1.3 Pre-incubation peat processing

The separated peat layers were thawed to +4 °C for 48 h covered within a plastic film to avoid the loss of soil water from the peat soil layer. After the peat thawed, it was transferred into a plastic container (cleaned and disinfected with 70 % ethanol between the handling of each sample). The thawed peat was manually homogenized; living roots, stones and big pieces of wood were removed. Every individual peat layer was similarly processed. During the homogenization procedure, the soils were kept in storage at +4 °C (±2 °C).

S1.4 Incubation procedure

We performed the peat incubation experiment with a set-up of five replicates of each peat soil layer (four peat cores with five peat layers) and an additional blank (incubation flask with similar atmosphere; without soil). In total 126 incubation flasks were incubated (Figure S3, Table S3) for 161 days (23 weeks) at aerobic and anaerobic oxygen conditions and three temperature treatments (+4, +10 and +16 °C). During the incubation experiment we performed during the first 5 weeks weekly gas samplings, later biweekly (13 samplings in total) (Figure S4). At the end of the incubation experiment, the incubated peat samples were collected for the analyses of chemical soil properties (Figure S4).

S1.4.1 Aerobic incubation procedure and gas sampling

We adjusted the water holding capacity (WHC) of homogenized peat, for the aerobic incubation, to a level of 60 % WHC. A subsample of 30 g of this prepared peat was transferred into sterilised air-tight 550 mL incubation flasks (Jouco Oy, Finland). For the aerobic incubation, flasks were flushed with air with a self-made bottle fan for 60 sec and closed with a rubber septum (Dätwyler, Switzerland) tightened with an aluminium crimp seal and transferred them into the dark at the three different incubation temperatures. We performed the aerobic incubation so that we ran several incubation intervals in which we took start– and end–point gas samples of a volume of 30 mL from each incubation flask. At the start–point sampling the gas sample volume was replaced with the exact same volume of air. After the end–point sample was taken the bottle was opened, equilibrated with air by flushing with the bottle fan for 60 sec closed again for the next incubation period. The gas samples were taken with a syringe (Terumo, Japan) connected to a needle (Terumo, Japan) by piercing through the flask septum and flushing the headspace three times before the sample was taken. 25 mL of each gas sample was immediately transferred into a vacuumed gas-exetainer (12 mL) (Labco Exetainer ®, UK) creating a necessary overpressure for gas chromatograph analysis. The gas samples were stored in these gas exetainers until analysed.

S1.4.2 Anaerobic incubation procedure and gas sampling

We prepared peat aliquots with a water holding capacity (WHC) of 100 %. 30 g of this prepared peat was transferred into sterilised air-tight 550 mL incubation flasks (Jouco Oy, Finland) and closed with a rubber septum tightened with an aluminium screw-cap. Anaerobic incubation requires an oxygen-free headspace in the incubation flasks. To prepare the oxygen-free headspace we flushed the incubation flasks with pure dinitrogen gas (N_2 5.0, AGA Industrial Gases, Finland) with a pressure of 1.5 bar for 10 minutes. The gas overpressure was released with a water locked pipe. Afterwards a volume of 5.5

ml of pure carbon dioxide (CO_2, AGA Industrial Gases, Finland) was added to the headspace to establish a CO_2 concentration of 1.0 % in the incubation headspace. Additionally, we added 30 ml of N_2 gas to create a slight overpressure in the flasks and sealed the rubber septa with a layer of grease and laboratory film (Parafilm ®, Bemis, USA). The gas sampling was performed in the same time series as the aerobic incubations with an offset of 24 hours. To control eventually occurring oxygen (O_2) in the incubation flask the O_2 concentration was measured before each gas sampling using a gas chromatograph (Hewlett Packard, HP 5890 series 2 plus, USA) with manual injection, allowing an instant O_2 concentration check of the incubation flasks. For the gas sampling an argon (Ar) gas filled sampling syringe (Ar 5.0, AGA Industrial Gases, Finland) was used to flush the needle and septum with Ar gas followed by immediate piercing through the septum. After flushing the headspace three times, a gas sample of 30 mL was taken. After the sample was taken the volume was replaced with dinitrogen gas (N_2 5.0, AGA Industrial Gases, Finland). 25 mL of each gas sample was immediately transferred in a vacuumed gas-exetainer (12 mL) (Labco Exetainer ®, UK) and stored until analysis.

The endpoint sampling of each incubation period was set as the starting point for the next incubation period. In case of present and increased O_2 concentrations in the incubation flasks (at 2 % O_2 in the incubation flask), the flask headspace was flushed with pure dinitrogen gas (N_2 5.0, AGA Industrial Gases, Finland) as described and a new starting point gas sample was taken.

S1.5 Gas chromatograph analyses

We analysed the gas sample concentrations of the greenhouse gases (GHG) methane (CH_4), carbon dioxide (CO_2) and nitrous oxide (N_2O) with a gas chromatograph (7890B GC System, Agilent Technologies, USA) in connection with an auto sampler for gas-exetainers (GX-271 Liquid Handler, Gilson, USA). The greenhouse gases were analysed in the gas chromatograph (GC) with different detecting systems, which included: 1) a flame ionization detector (FID) for CH_4, 2) a thermal conductivity detector (TCD) for CO_2 and an electron caption detector (ECD) for N_2O gas concentration detection. For the determination of the sample gas concentrations, we analysed the peak area of the samples in comparison to the peak area of two different standard gases. The standard gases used had the GHG concentrations in parts per million (ppm) of 398 / 3990 ppm CO_2, 2.02 / 15 ppm CH_4 and 0.836 / 5.01 ppm N_2O. All gas samples from one gas sampling were analysed in in one GC run. We analysed the gas samples in their original concentrations and of 1:20 dilutions (dilution with N_2 5.0 gas, AGA Industrial Gases, Finland) to detect sample concentrations exceeding the higher standard gas concentrations.

Small negative CO_2 and CH_4 fluxes under anaerobic conditions, observed occasionally, were considered erroneous and set to zero for the calculation of the cumulative gas production. Blank incubation bottles were run in parallel with the peat incubation to check on possible gas leaks from the incubation bottles or O_2 input to anaerobic bottle after during the incubation period.

135

136 **S1.6 Physical and chemical soil properties of homogenised peat**

137 Immediately after the peat layers have been thawed duplicate samples of a defined volume of peat soil
138 were taken to determine the dry bulk density (BD) of the undisturbed (unprocessed) soil structure. After
139 the thawing of the peat layers the peat soil was homogenized, roots and stones were removed. Before
140 the start of the soil incubations, we determined soil properties (dry weight, bulk density, water holding
141 capacity, pH, soil organic matter content) and the concentration of C and N compounds (ammonium
142 (NH_4^+-N), nitrate (NO_3-N), dissolved organic carbon (DOC), dissolved organic nitrogen (DON).
143 Further, we analysed microbial biomass carbon (chloroform fumigation extraction), and from soil
144 extracts the specific ultraviolet absorbance at 254 nm ($SUVA_{254}$).
145

146 **S1.6.1 Bulk density**

147 Fresh homogenized peat soil was transferred into a measuring cylinder up to a volume of 60 mL. The
148 measuring cylinder is knocked vertically knocked three times down the table to compress the soil. More
149 soil was added to the measuring cylinder up to the volume of 60 mL. When the defined soil volume
150 was reached, the weight of the cylinder and soil is measured. This procedure was performed in
151 duplicates for each soil sample. The fresh bulk density of homogenized soil was calculated acc. equation
152 (eqn.) 1. Dry bulk density was calculated acc. eqn. 2.
153

154 $$Fresh\ bulk\ density\ \left(BD\,\frac{g}{cm^3}\right) = \frac{(fresh\ soil\ [g])}{soil\ volume\ [cm^3]} \quad (1)$$
155

156 $$Dry\ bulk\ density\ (BD\ gDW/cm^3) = Fresh\ bulk\ density\ \times\ dry\ weight\ [g/g] \quad (2)$$
157

158 **S1.6.2 Water holding capacity (WHC)**

159 Plastic funnels were prepared on funnel racks with a closable silicone tube. Filter papers were folded
160 and moistened with ultrapure water (Milli-Q™, MilliporeSigma, USA). The moist filter paper weight
161 was measured, and the filters were transferred into the funnels. A defined volume of homogenized peat
162 soil weight was measured and transferred into the moist filter in the funnel (performed in duplicates).
163 Then ultrapure water (Milli-Q™, MilliporeSigma, USA) was added to the funnels until the soil was
164 fully submerged. The funnels were covered with aluminium foil, and the soil was kept in the water for
165 exact 24 hours. After this period the silicone tubes of the funnels were opened to remove the water from
166 the funnels. The excess water was allowed to drop off for one hour, then the weight of moist filter and
167 soil was measured. The water holding capacity of homogenized peat soil was calculated by following
168 equation.

169

170 $$Water\ holding\ capacity\ \left(100\ \%\ WHC\ \frac{H2O\ [g]}{dry\ soil\ [g]}\right) = \frac{(wet\ soil\ [g] - dry\ soil[g])}{dry\ soil\ [g]} \quad (3)$$

171

172 $$Natural\ water\ holding\ capacity\ (WHC\ \%) = \frac{\left(gravimetric\ H2O\ content \frac{H2O\ [g]}{dry\ soil\ [g]}\right) \times 100}{\left(100\ \%\ WHC \frac{H2O[g]}{dry\ soil\ [g]}\right)} \quad (4)$$

173 **S1.6.3 Dry weight and gravimetric water content**

174 After the homogenisation of the peat soil layers, about 50 g of fresh soil were dried at + 60.0 ± 1 °C
175 (Termaks™ TS 8000 series, Norway) for 48 hours. After the drying the soil sample weights was
176 measured until stabilization is reached. The dry weight content and gravimetric water content of the soil
177 was calculated by following equations.

178

179 $$Dry\ weight\ [g/g] = \frac{dry\ soil\ [g]}{fresh\ soil\ [g]} \quad (5)$$

180

181 $$Dry\ weight\ [\%] = \frac{dry\ soil\ [g]}{fresh\ soil\ [g]} \times 100 \quad (6)$$

182

183 $$Gravimetric\ water\ content\ \left(\frac{g\ H2O}{g\ dry\ soil}\right) = \frac{(fresh\ soil\ [g] - dry\ soil\ [g])}{dry\ soil\ [g]} \quad (7)$$

184

185 **S1.6.4 Soil organic matter (SOM) content (loss of ignition)**

186 An amount of maximum 1 g of dried homogenized peat soil was transferred into a weight stabilized
187 porcelain crucible (burned for 1 h at 550.0 ± 2 °C). The crucibles with the dried soils were transferred
188 into a muffle oven (Nabertherm Laboratory Furnace B170, Germany) and burned at temperature of 550
189 ± 2 °C for two hours. After cooling, the weight of the temperature stabilized crucibles with the ash was
190 measured. The soil organic matter (SOM) content was calculated by following equations.

191

192 $$Ash\ [\%] = \frac{(crucible + ash\ [g]) - crucible\ empty\ [g]}{dry\ soil\ [g]} \quad (8)$$

193

194 $$Soil\ organic\ matter\ (SOM)\ [\%] = 100 - ash\ [\%] \quad (9)$$

195

196 **S1.6.5 Total carbon and nitrogen (TOC/N)**

197 Sub-samples of the homogenized peat soil layers were dried at 60 ± 1 °C (Termaks™ TS 8000 series,
198 Norway) for 48 hours. The dried soil was transferred into a 2 mL tube (Eppendorf AG, Germany) with
199 a stainless-steel grinding ball and milled with a mixer mill (MM301, Retsch, Germany) for 30 seconds.

The total amount of carbon (C) and nitrogen (N) of the grinded soils were determined using an elemental analyser (Vario micro 209 cube, Elementar Analysensysteme GmbH, Germany).

S1.6.6 Particle density and water filled pore space of peat

The analysis procedure of the particle density determination was performed according to Heiskanen, 1992. Subsamples of peat soil were dried at + 60.0 ± 1 °C (Termaks™ TS 8000 series, Norway) for 48 hours. The dried soil was sieved through a 2 mm mesh-size sieve. Clean and dry pycnometers (Brand GmbH & Co KG, Germany) were weighted and filled to one third of its volume with dried and sieved peat soil. Each soil sample was analysed in triplicates. Ultrapure water (Milli-Q™, MilliporeSigma, USA) was boiled for 15 min to remove dissolved gases. The pycnometers were filled up to two thirds of the volume with the degassed water and placed on a sand bath (Clifton® Nickel-Electro Ltd., UK) (adjusted to a temperature of 230 °C). The liquid-soil mixture is boiled for 15 min to remove air present in the soil structure. After cooling the pycnometers are fully filled with degassed water and weighted. After weighing the temperature of the soil-water slurry is measured, so that the water density can be determined for the calculations. Particle density, total porosity and water filled pore space are calculated using the water density, pycnometer mass and volumes, and soil dry weight, soil dry bulk density with following equations.

Volume of both organic and mineral matter in the soil (V_s):

$$V_s = V_p - \left(\frac{M_{psl}-M_p-M_s}{D_1}\right) \quad (10)$$

V_p = The volume of the pycnometer (cm^3)

M_{psl} = Mass of pycnometer + dry soil + added water (g)

M_p = Mass of pycnometer (g)

M_s = Mass of dry soil (g)

D_1 = Density of the added water (g/cm^3)

Particle density (PD):

$$PD = \frac{M_S}{V_S} \quad (11)$$

M_S = Dry mass of both organic and mineral matter in the soil (g)

V_S = Volume of both organic and mineral matter in the soil (cm^3)

Total porosity (cm^3 pores / cm^3 soil):

$$S_t = 1 - (BD - PD) \quad (12)$$

BD = Bulk density (g_{DW}/ cm^3)

PD = Particle density (g_{DW}/cm^3)

Water content calculated forwards soil volume (cm^3 H_2O/ cm^3 soil):

$$V_b = BD \times W_{DW} \quad (13)$$

BD = Bulk density (g_{DW} / cm^3):

W_{DW} = Water content calculated forwards dry weight (g H_2O /g_{DW}).

Water filled pore space (WFPS %):

$$WFPS\ \% = 100 \times \frac{V_b}{S_t} \quad (14)$$

V_b = Volumetric water content (cm^3 H_2O/ cm^3)

S_t = Total porosity

S1.6.7 pH

For the pH determination, a defined volume of homogenized peat soil was mixed with ultrapure water (Milli-Q™, MilliporeSigma, USA) with a ratio of 1:2 (v/v). The soil water mixture was left for equilibration for 30 minutes at room temperature. Afterwards the pH was measured using a prior calibrated pH meter (pH meter pH340 with pH electrode SenTix ® 81, WTW, Weilheim, Germany). After the pH measurement additional ultrapure water was added to reach a soil water ration of 1:3 (v/v) and the soils were extracted on a platform shaker (Innova 2300, New Brunswick Scientific, USA) for 2 h at 175 rpm and later filtrated trough ash less filter paper (Whatman GE Healthcare, 589/3, UK). These water extracts were later used to determine soil nitrate nitrogen (NO_3^--N) and for the analyses of DOC concentration and the specific ultraviolet absorbance ($SUVA_{254}$).

S1.6.8 Dissolved organic carbon (DOC), dissolved nitrogen (DN) and microbial biomass carbon (C_{mic})

Contents for DOC and DN were determined from K_2SO_4 extracts of the fumigation control extracts. Microbial biomass carbon (C_{mic}) was analysed with a modification of the fumigation-extraction methods according to Vance et al., 1987. For the determination, two separate soil samples of 5 g of each peat layer were prepared. As a fumigation control, one sample was directly added into an extraction flask and extracted for 2 h with 20 mL of 0.5 M K_2SO_4 solution (1:4 w/v) by rotation shaking at 175 rpm (Innova 2300, New Brunswick Scientific, USA) and filtrated through ash less filter paper (Whatman GE Healthcare, 589/3, UK).

For the fumigation, soil samples were transferred in aluminium dishes and placed into a desiccator (providing moist atmosphere) in addition with ethanol-free chloroform ($CHCl_3$) (amylene-stabilized $CHCl_3$, Sigma-Aldrich, Germany). The desiccator was set under vacuum for ~15 min until the desiccator volume was filled with chloroform vapour. The fumigation of the soil samples lasted for 24 h. Afterwards chloroform in the soil samples was removed by repeated evacuation of the desiccator until no chloroform could be noticed in the samples anymore. Finally, the fumigated samples were also transferred into extraction flasks and extracted for 2 h with 20 mL of 0.5 M K_2SO_4 solution (1:4 w/v)

by rotation shaking at 175 rpm (Innova 2300, New Brunswick Scientific, USA) and filtrated through ash less filter paper (Whatman GE Healthcare, 589/3, UK). Total dissolved organic carbon (DOC) and dissolved nitrogen (DN) of the extracts was measured with a TOC/TN analyser (LiquicTOC II, Elementar, Germany). Dissolved organic nitrogen (DON) was calculated by subtracting the mineral N content (NH_4^+ and NO_3^-) from dissolved nitrogen content.

Values for microbial biomass carbon (C_{mic}) were calculated as the difference between control extractions and fumigated peat extractions. Values were corrected for incomplete extraction of C_{mic} (factor K_{EC} 0.38) (Vance et al., 1987). Values were calculated as µmol per gram dry weight (µmol C g^{-1} DW).

S1.6.9 Specific ultraviolet absorbance ($SUVA_{254}$) and aromaticity

Water extracts of peat samples (from pH determination) were filtrated through a sterile 0.45 µm syringe filter (Porvair Sciences, UK). The filtrated water samples were analysed with a TOC/TN analyser (Multi N/C 2100S, Analytic Jena AG, Germany). The amount of DOC was analysed in mg L^{-1}. For the specific ultraviolet absorbance, the water extracts used for DOC analysis were filtrated through a sterile 0.45 µm syringe filter (Porvair Sciences, UK). A volume of ~ 3 mL of filtrated water extract was transferred into a quartz glass cuvette (Starna®, Optiglass Ltd., UK) with width of 1.0 cm. The ultraviolet (UV) absorbance at 254 nm was measured using a UV spectrophotometer (UV-2401PC UV-VIS recording spectrophotometer, Shimadzu, Japan). The $SUVA_{254}$ value is calculated according Weishaar et al., 2003 where the absorbance at 254 nm is calculated in inverse metres (m^{-1}) and divided by the DOC concentration in mg L^{-1}.

$$SUVA_{254}\,[\text{L mg C}^{-1}\,\text{m}^{-1}] = \frac{absorbance\ (254\ nm)[cm^{-1}] \times 100}{DOC\ [mg\ L^{-1}]} \quad (15)$$

With the $SUVA_{254}$ value we calculated the portion of aromatic compounds, defined as aromaticity, in % DOC according to Weishaar et al., 2003 with following equation.

$$\text{Aromaticity}\ [\%\ \text{DOC}] = 6.52 \times SUVA_{254} + 3.63 \quad (16)$$

S1.6.10 Ammonium (NH_4^+-N) and nitrate (NO_3^--N) content

Ammonium (NH_4^+-N) was analysed by the photometric determination of K_2SO_4 extracts of the different homogenized peat soil layers based on a modified method described by Fawcett & Scott, 1960. 5 g of peat soil were mixed with 20 mL of 0.5 M K_2SO_4 solution (soil extractant ratio of 1:4 w/v), shaken at 175 rpm (Innova 2300, New Brunswick Scientific, USA) filtrated through ash less filter paper (Whatman® GE Healthcare, 589/3, UK) (extractions of microbial biomass fumigation control were

used). 50 µL of filtrated K_2SO_4 extracts and NH_4^+-N standard solutions were transferred to a 96-well microplate (CELLSTAR® Greiner Bio-One, Austria). With the addition of 50 µL sodium-phenate, 75 µL sodium-nitroprusside and 75 µL sodium-hypochlorite a reaction is induced developing a blue colour. Depending on the NH_4^+-N concentration the colour intensity differs. The absorbance of the sample reactions & a standard series of known concentrations was measured at a wavelength at 650 nm using a multilabel plate reader (1420 VICTOR^3™, PerkinElmer, USA). Sample NH_4^+-N concentrations were calculated as mg NH_4^+-N kg^{-1} DW.

Nitrate (NO_3^--N) concentrations in the peat soil layers were determined from water extracts of the peat soil samples. The determination is based on a modified method described by Miranda, Espey, & Wink, 2001. We added an additional volume of ultrapure water (Milli-Q™, MilliporeSigma, USA) to the soil-water slurries for pH determination after the pH measurements to increase the soil to water ratio to 1:3 (v/v). The soil water mixtures were shaken at 175 rpm (Innova 2300, New Brunswick Scientific, USA) and filtrated through ash less filter paper (Whatman® GE Healthcare, 589/3, UK). We transferred 100 µL of filtrated water extracts and NO_3^--N standard solutions series to a 96-well microplate (CELLSTAR® Greiner Bio-One, Austria). 100 µL of Griess reagent (1:1 mixture of N-naphthyl ethylenediamine dihydrochloride solution and sulphanilamide solution) and 20 µL of saturated Vanadium (III) chloride (VCl_3) are added which react with the nitrate creating a red colour. After a 90 minutes incubation at + 37 °C (laboratory incubator Termaks B 8133 series) we measured the absorbance at 540 nm using a multilabel plate reader (1420 VICTOR^3™, PerkinElmer, USA). Sample NO_3^--N concentrations were calculated as mg NO_3^--N kg^{-1} DW.

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S3 Supplementary figures

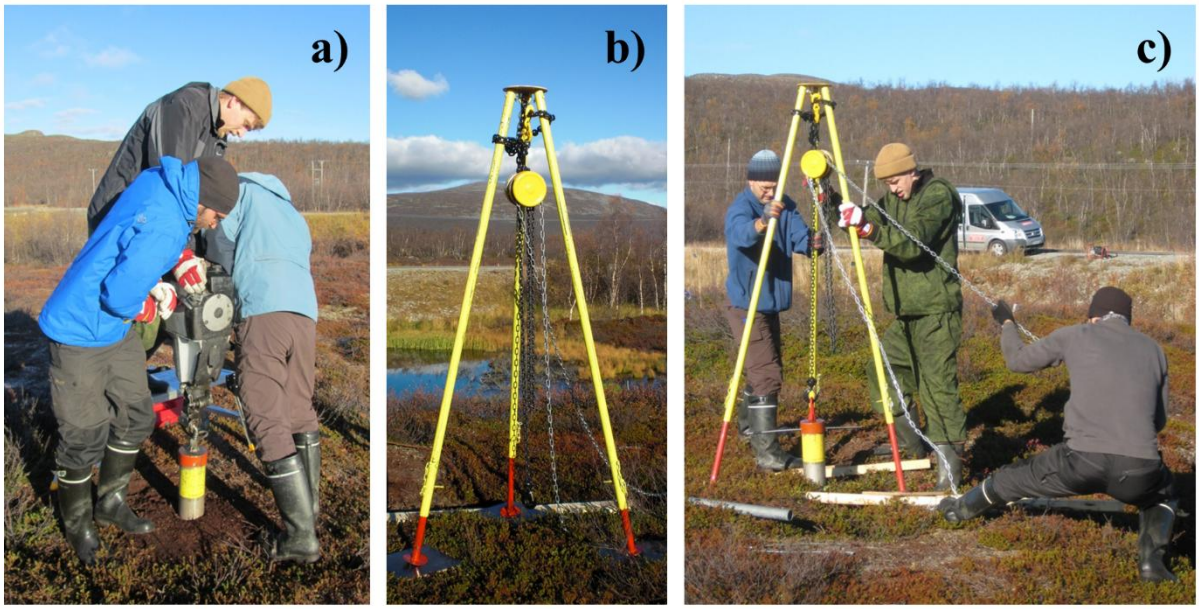

Figure S1: Collection of intact peat cores a) Pneumatic drill hammering of the stainless-steel coring cylinder into the peat soil; b) Lifting system connected on a tripod; c) Pulling the intact peat soil core from the ground with the hoist lifting system. Photographs taken by C. Voigt, 2012.

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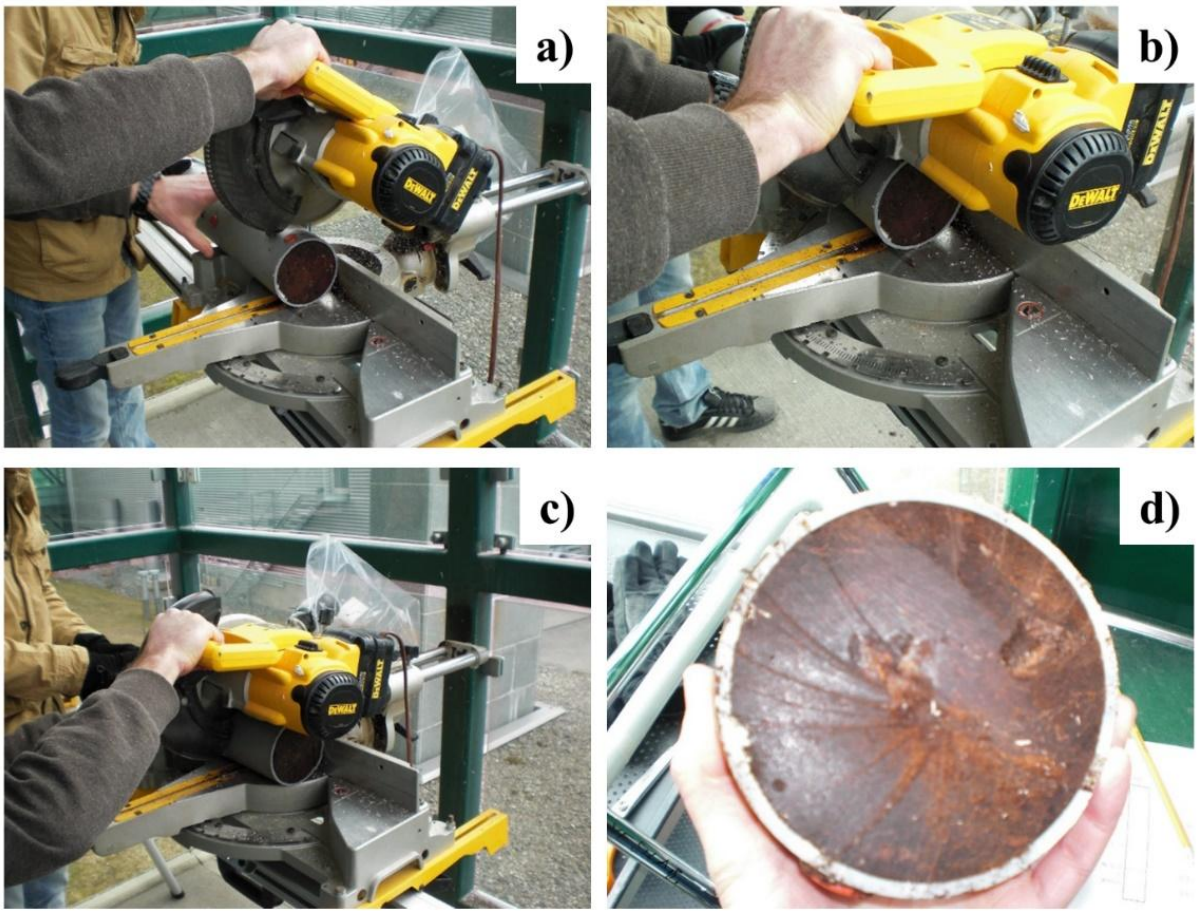

387

388 **Figure S2: Dividing the intact peat soil cores in defined peat layers: a) to c) cutting the frozen peat within the**
389 **polypropylene (PP) tube using an electrical circular saw; d) peat layer after the cutting. Photographs taken by K.**
390 **Diáková, 2014.**

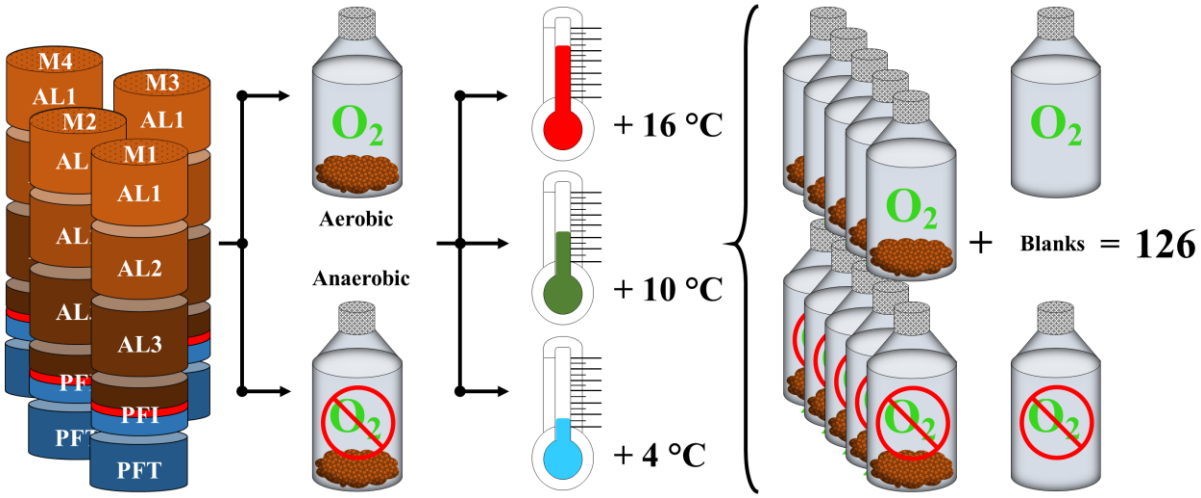

Figure S3. Schematic overview of the incubation set-up. Four intact peat cores (mesocosms M1 – M4) were separated in five peat soil layers. Homogenized peat soil aliquots of the layers were incubated at aerobic and anaerobic conditions at the temperatures 4 °C, 10 °C and 16 °C in air-tight incubation flasks for 161 days. Including blanks a total of 126 incubation flasks were handled in this procedure.

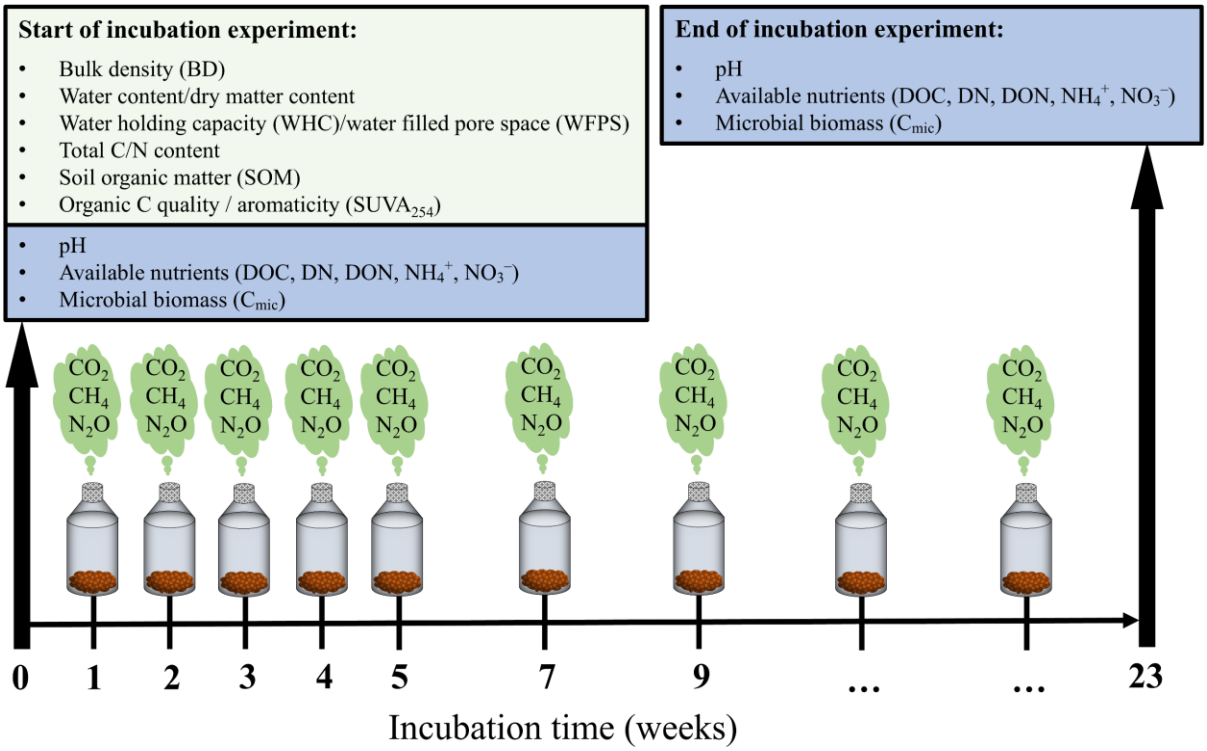

Figure S4: Schematic overview of the incubation procedure. After cutting the peat cores and homogenisation of the separate peat soil layers, soil properties necessary for the incubation settings were analysed. Additionally, nutrients and microbial biomass of the peat soil layers was analysed before and after the incubation period. During the incubation, gas samples were taken weekly in the first five weeks, and biweekly afterwards. In total, the incubation period was 161 days (23 weeks) with 13 gas samplings.

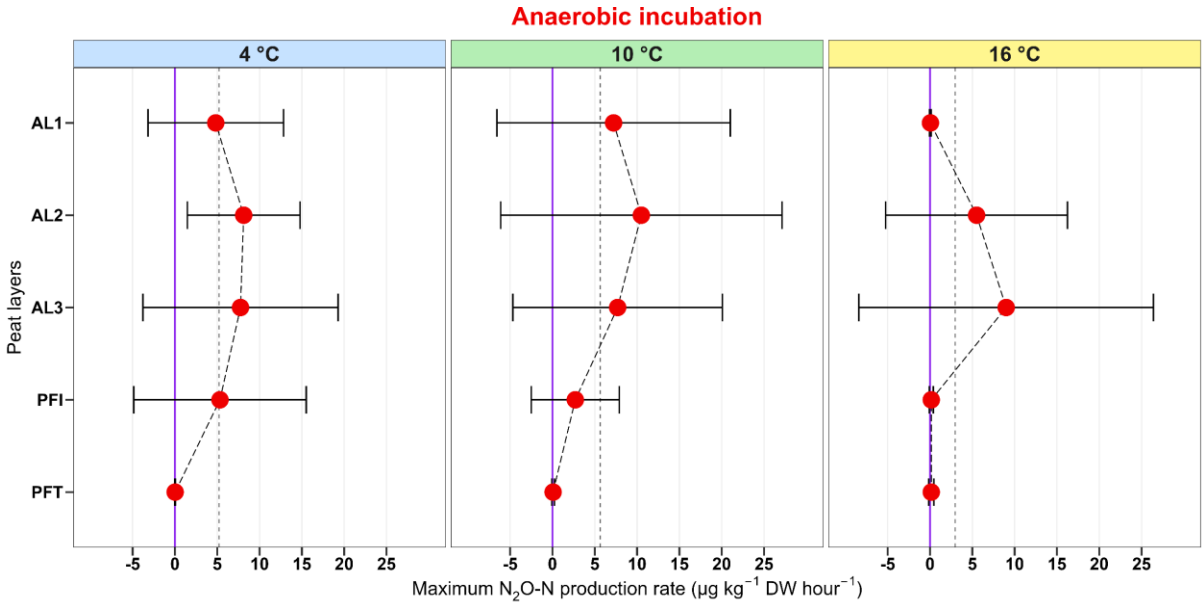

Figure S5: Anaerobic maximum N_2O-N production rates per hour in the different incubation temperatures of 4, 10 and 16 °C during the incubation period of 161 days. Data points represent mean values; error bars show standard deviation (n = 4). Dashed grey line in the background represents the mean value across all five peat layers at the given temperature. There were no significant statistical differences of the maximum rates between peat layers or between the different incubation temperatures seen.

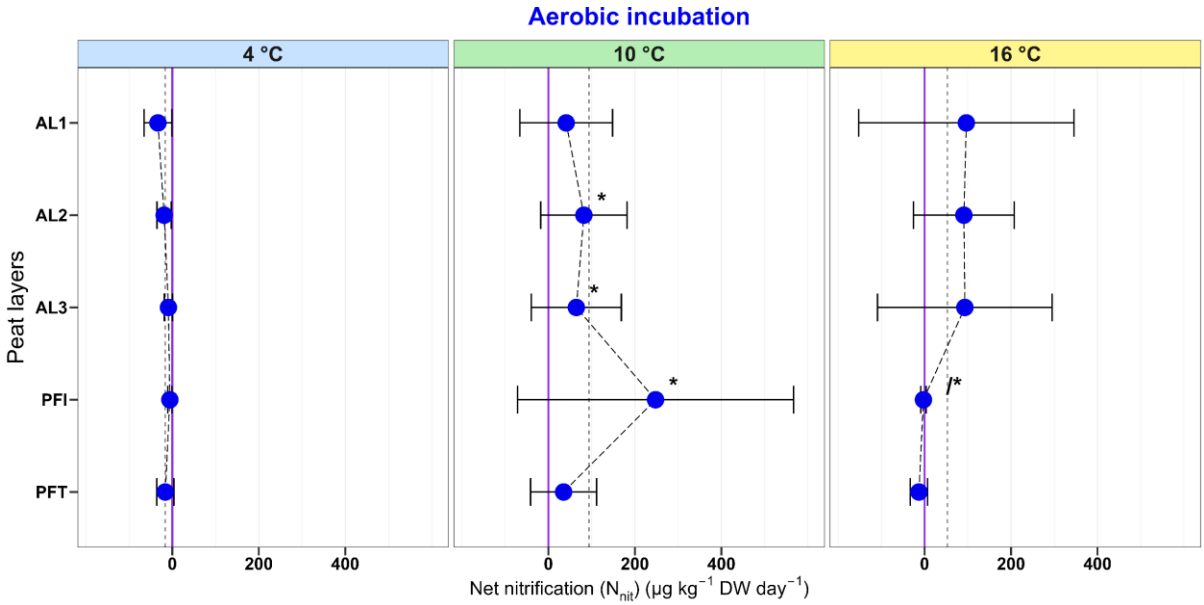

Figure S6: Aerobic nitrification rates per day at 4, 10 and 16 °C during the incubation period of 161 days. Data points represent mean values; error bars show standard deviation (n = 4). Asterisks indicate significant differences between incubation temperatures: for 10 °C, significant differences to 4 °C; for 16 °C significant difference to 4 °C/10 °C. Dashed grey line in the background represents the mean value across all five peat layers at the given temperature. Level of significance: ***significant at $P \leq 0.001$, ** significant at $P \leq 0.01$, *significant at $P \leq 0.05$.

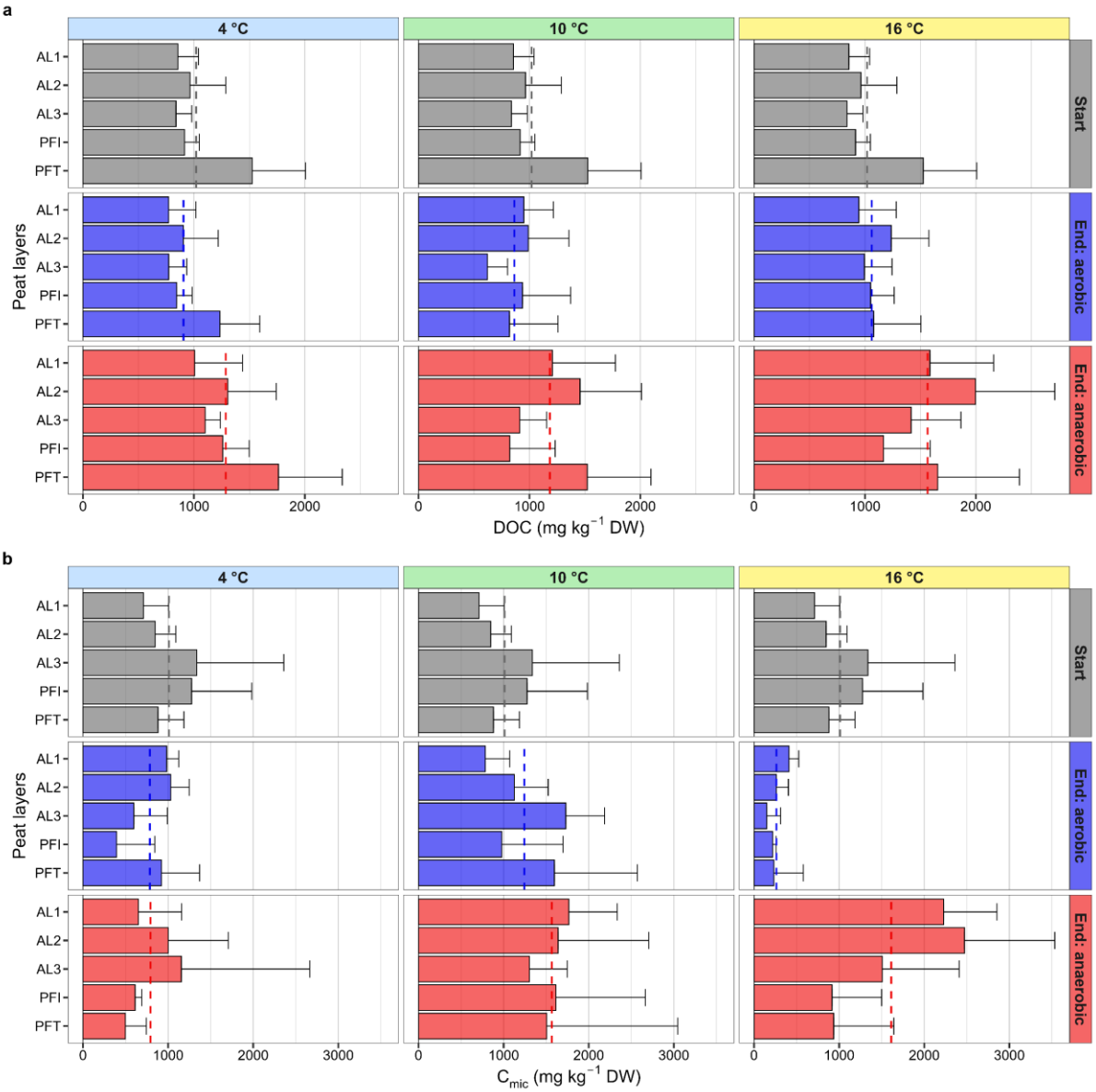

Figure S7: Initial and end values of dissolved organic carbon (DOC) and microbial carbon (C_{mic}) at aerobic and anaerobic incubations at temperatures of 4, 10 and 16 °C. Grey bars represent initial values, blue and red bars indicate values after the incubation in aerobic and anaerobic conditions, respectively. The dotted coloured lines in the panels represent the mean peat profile value at certain incubation temperature and state.

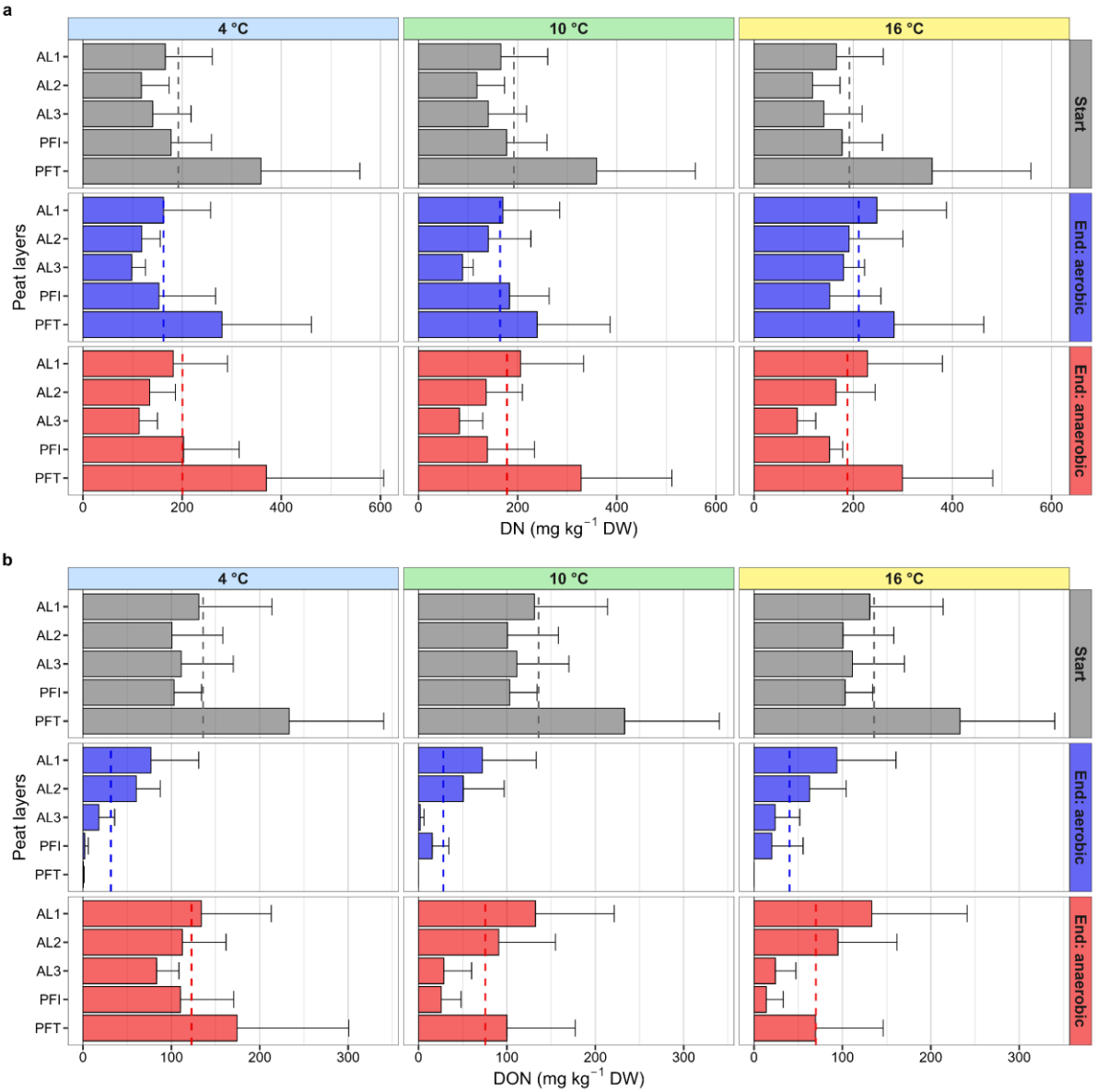

Figure S8: Initial and end values of total dissolved nitrogen (DN) and dissolved organic nitrogen (DON) at aerobic and anaerobic incubations at temperatures of 4, 10 and 16 °C. Grey bars represent initial values, blue and red bars indicate values after the incubation in aerobic and anaerobic conditions, respectively. The dotted coloured lines in the panels represent the mean peat profile value at certain incubation temperature and state.

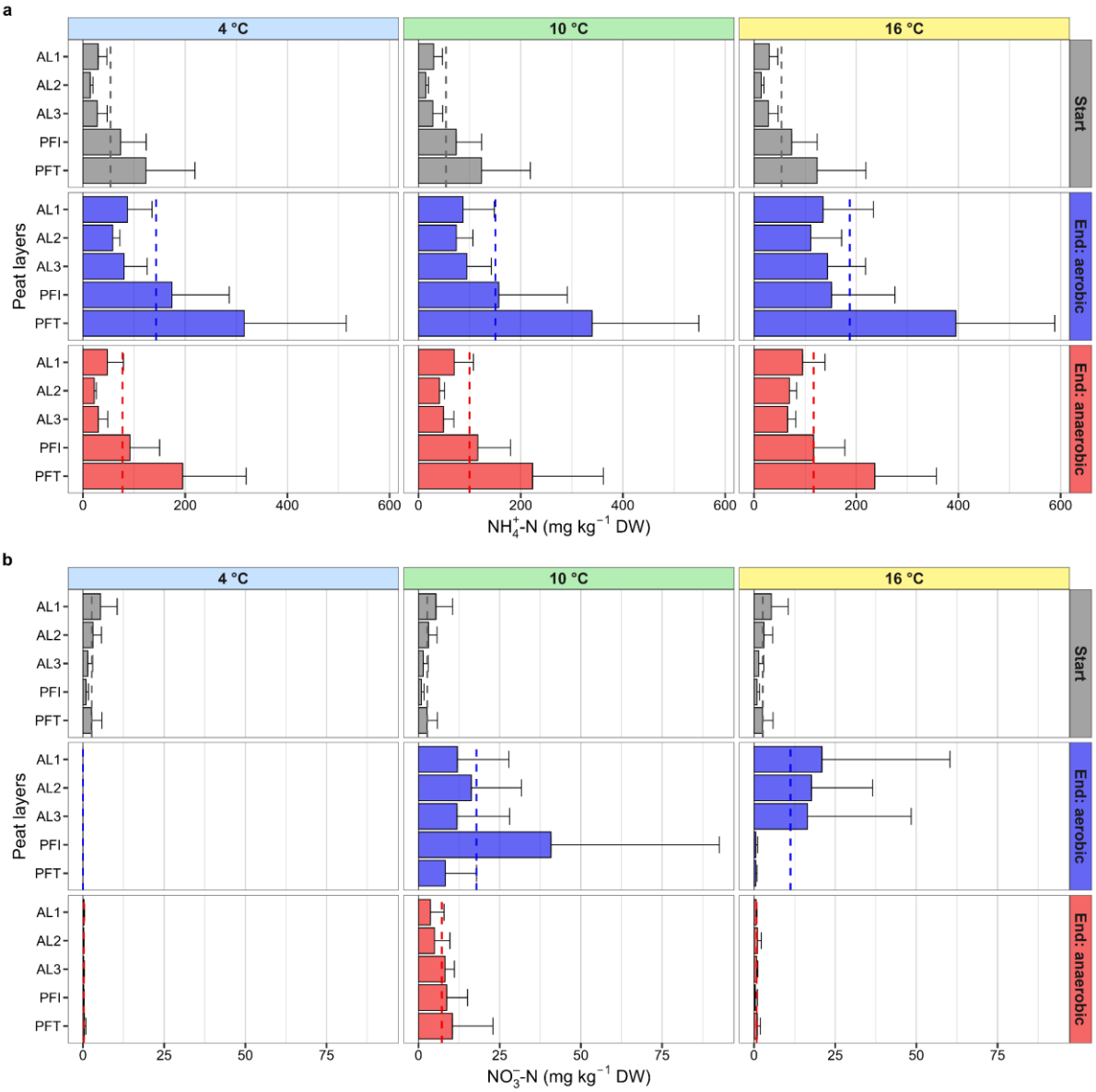

Figure S9: Initial and end values of ammonium (NH_4^+-N) nitrate (NO_3^--N) at aerobic and anaerobic incubations at temperatures of 4, 10 and 16 °C. Grey bars represent initial values, blue and red bars indicate values after the incubation in aerobic and anaerobic conditions, respectively. The dotted coloured lines in the panels represent the mean peat profile value at certain incubation temperature and state.

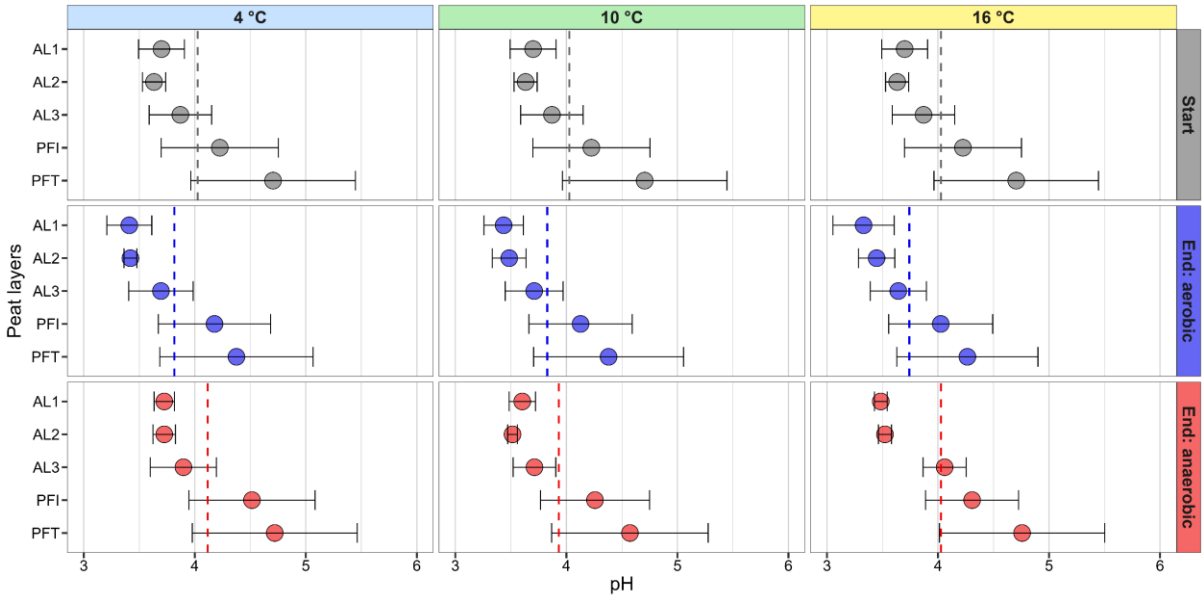

Figure S10: Initial and end values of pH of aerobic and anaerobic incubations at temperatures of 4, 10 and 16 °C. Grey circles represent initial values, blue and red circles indicate values after the incubation in aerobic and anaerobic conditions, respectively. The dotted coloured lines in the panels represent the mean peat profile value at certain incubation temperature and state.

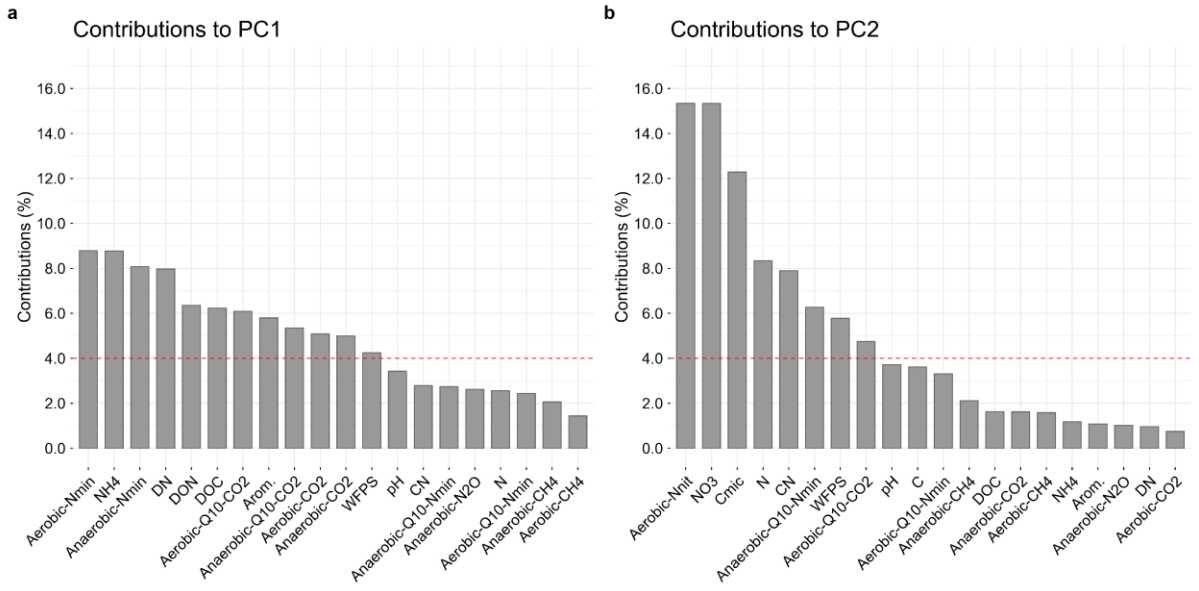

Figure S11: Aerobic and anaerobic incubation at 4°C principal component analysis (PCA) contributions of the different variables to the principal component 1 (PC1, a) and principal component 2 (PC2, b). The red dotted line in the contribution graphs represents the average contribution of variables to the principal component. Variables above the line have a significant contribution.

S4 Supplementary tables

Table S1: Identification code and dimensions (cm) of bare surface peat cores used for the incubation experiment. In the left column: identification codes of the different peat layers. The equivalent layer depths and the length of the individual fragment (the peat layer) are represented in columns on the right.

Peat core ID	**M1 (7 bare)**		**M2 (10 bare)**		**M3 (12 bare)**		**M4 (14 bare)**	
Peat layer	**Layer depth [cm]**	**Fragment length [cm]**	**Layer depth [cm]**	**Fragment length [cm]**	**Layer depth [cm]**	**Fragment length [cm]**	**Layer depth [cm]**	**Fragment length [cm]**
Active layer 1 (**AL1**)	0–17.0	17.0	0–22.0	22.0	0–21.0	21.0	0–19.0	19.0
Active layer 2 (**AL2**)	17.0–34.0	17.0	22.0–44.0	22.0	21.0–42.0	21.0	19.0–38.0	19.0
Active layer 3 (**AL3**)	34.0–51.0	17.0	44.0–66.0	22.0	42.0–63.0	21.0	38.0–57.0	19.0
Permafrost interface (**PFI**)	51.0–61.0	10.0	66.0–76.0	10.0	63.0–73.0	10.0	57.0–67.0	10.0
Permafrost table (**PFT**)	61.0–71.0	10.0	76.0–86.0	10.0	73.0–83.0	10.0	67.0–77.0	10.0
Full core length [cm]	**71.0**		**86.0**		**83.0**		**77.0**	

Table S2: Radiocarbon (^{14}C) dating of one intact peat core (M4 / 14 bare). The peat layers are named as active layer 1 to 3 (AL1, AL2 and AL3), permafrost interface (PFI) and permafrost layer (PFT). The ^{14}C age is given in years before present (BP).

Peat layer	^{14}C age (years BP)
AL1	1480 ± 30
AL2	2890 ± 30
AL3	4710 ± 35
PFI	5680 ± 35
PFT	5835 ± 35

Table S3: Number of samples incubated at the given temperatures and oxygen (aerobic and anaerobic) conditions.

Peat cores (replicates)	Peat layers	Incubation temperature (°C)	n of aerobic incubation (n blank)	n of anaerobic incubation (n blank)
M1 – M4 (n = 4)	AL1, AL2, AL3, PFI, PFT (n = 5)	+4	20 (1)	20 (1)
		+10	20 (1)	20 (1)
		+16	20 (1)	20 (1)
Total number of incubated samples (blanks)			**120 (6)**	

Table S4: Daily rates and cumulative aerobic greenhouse gas (GHG) production (incubation period of 161 days) (mean ± standard deviation, n = 4). Greenhouse gas production differences by peat layer (One-way ANOVA and Tukey's HSD / Kruskal-Wallis and Dunn's test) are indicated with grouping letters (a, ab, b). Significant *P*-values (One-way ANOVA / Kruskal-Wallis) of greenhouse gas production / flux differences between incubation temperatures are indicated with bold letters and asterisks. Level of significance: * significant at $P \leq 0.001$, **significant at $P \leq 0.01$, *significant at $P \leq 0.05$. * CO2 production rate unit is presented in mg C kg^{-1} dry weight day^{-1}. CH_4 is presented as µg C kg^{-1} DW day^{-1} and N_2O in µg N kg^{-1} DW day^{-1}.**

Incubation temperature		4 °C			10 °C				16 °C				
GHG	Peat layer	Production rate (µg C kg^{-1} dry weight day^{-1})	Cumulative production (mg C kg^{-1} dry weight)	Peat layer groups	Production rate (µg C kg^{-1} dry weight day^{-1})	Cumulative production (mg C kg^{-1} dry weight)	Peat layer groups	*P*-value (4/10 °C)	Production rate (µg C kg^{-1} dry weight day^{-1})	Cumulative production (mg C kg^{-1} dry weight)	Peat layer groups	*P*-value (4/16 °C)	*P*-value (10/16 °C)
CO_2	AL1	3773.56 ± 1559.79	607.54 ± 251.13	**ab**	10134.79 ± 4417.73	1631.70 ± 711.25	a	**0.022***	28388.28 ± 14875.50	4570.51 ± 2394.96	a	**0.001****	**0.035***
	AL2	2340.10 ± 700.09	376.76 ± 112.71	**b**	5793.07 ± 1060.39	932.68 ± 170.72	a	**0.001****	14094.36 ± 2632.22	2269.19 ± 423.79	a	**0.000*****	**0.001****
	AL3	2748.74 ± 327.03	442.55 ± 52.65	**ab**	5928.40 ± 946.97	954.47 ± 152.46	a	**0.000*****	14141.16 ± 946.17	2276.73 ± 152.33	a	**0.000*****	**0.000*****
	PFI	4125.55 ± 1548.21	664.21 ± 249.26	**ab**	8234.32 ± 2282.09	1325.72 ± 367.42	a	**0.025***	17658.74 ± 5341.70	2843.06 ± 860.01	a	**0.003****	**0.018***
	PFT	7203.87 ± 3725.97	1159.82 ± 599.88	**a**	11489.12 ± 5076.19	1849.75 ± 817.27	a	0.222	21079.41 ± 7234.60	3393.78 ± 1164.77	a	**0.014***	0.073
	Mean	4038.37 ± 2476.32	650.17 ± 398.69		8315.94 ± 3694.49	1338.87 ± 594.81			19072.39 ± 8878.04	3070.65 ± 1429.36			
CH_4	AL1	-2.35 ± 2.01	-0.38 ± 0.32	**a**	-2.72 ± 2.20	-0.44 ± 0.35	**a**	0.564	-2.79 ± 2.05	-0.45 ± 0.33	**a**	0.564	0.773
	AL2	-0.01 ± 0.75	0.00 ± 0.12	**ab**	-0.10 ± 0.74	-0.02 ± 0.12	**ab**	0.387	-0.09 ± 0.83	-0.02 ± 0.13	**ab**	1.000	0.773
	AL3	0.03 ± 0.77	0.01 ± 0.12	**ab**	-0.22 ± 1.29	-0.04 ± 0.21	**ab**	0.564	0.34 ± 0.37	0.05 ± 0.06	**ab**	0.773	0.773
	PFI	0.55 ± 0.19	0.09 ± 0.03	**ab**	0.58 ± 0.16	0.09 ± 0.03	**b**	1.000	2.31 ± 3.13	0.37 ± 0.50	**b**	0.083	0.149
	PFT	0.82 ± 0.20	0.13 ± 0.02	**b**	0.81 ± 0.20	0.13 ± 0.03	**b**	0.564	0.90 ± 0.13	0.15 ± 0.02	**b**	0.248	0.564
	Mean	-0.19 ± 1.47	-0.03 ± 0.24		-0.33 ± 1.67	-0.05 ± 0.27			0.13 ± 2.30	0.02 ± 0.37			
N_2O	AL1	0.27 ± 0.33	0.04 ± 0.05	a	0.82 ± 1.40	0.13 ± 0.23	a	0.248	2.23 ± 4.15	0.36 ± 0.67	a	0.149	0.387
	AL2	0.23 ± 0.22	0.04 ± 0.04	a	0.45 ± 0.48	0.07 ± 0.08	a	0.387	0.84 ± 0.88	0.14 ± 0.14	a	0.248	0.248
	AL3	0.13 ± 0.07	0.02 ± 0.01	a	0.29 ± 0.28	0.05 ± 0.04	a	0.248	0.64 ± 0.80	0.10 ± 0.13	a	0.149	0.387
	PFI	0.11 ± 0.11	0.02 ± 0.02	a	0.33 ± 0.49	0.05 ± 0.08	a	0.564	0.46 ± 0.73	0.07 ± 0.12	a	0.387	0.773
	PFT	0.08 ± 0.03	0.01 ± 0.00	a	0.09 ± 0.07	0.01 ± 0.01	a	0.387	0.12 ± 0.03	0.02 ± 0.00	a	0.083	0.387
	Mean	0.16 ± 0.18	0.03 ± 0.03		0.40 ± 0.68	0.06 ± 0.11			0.86 ± 1.89	0.14 ± 0.30			

Table S5: Daily rates and cumulative anaerobic greenhouse gas (GHG) production of CO_2 and CH_4 (incubation period of 161 days) (mean ± standard deviation, n = 4). Greenhouse gas emission differences by peat layer (One-way ANOVA and Tukey's HSD / Kruskal-Wallis and Dunn's test) are indicated with grouping letters (a, ab, b). Significant *P*-values (One-way ANOVA / Kruskal-Wallis) of greenhouse gas production / flux differences between incubation temperatures are indicated with bold letters and asterisks. Level of significance: * significant at $P \leq 0.001$, **significant at $P \leq 0.01$, *significant at $P \leq 0.05$. * CO2 production rate unit is presented in mg C kg^{-1} dry weight day^{-1}. CH_4 production rate is presented as µg C kg^{-1} DW day^{-1}.**

Incubation temperature		4 °C			10 °C				16 °C				
GHG	Peat layer	Production rate (µg C kg^{-1} dry weight day^{-1})	Cumulative production (mg C kg^{-1} dry weight)	Peat layer groups	Production rate (µg C kg^{-1} dry weight day^{-1})	Cumulative production (mg C kg^{-1} dry weight)	Peat layer groups	*P*-value (4/10 °C)	Production rate (µg C kg^{-1} dry weight day^{-1})	Cumulative production (mg C kg^{-1} dry weight)	Peat layer groups	*P*-value (4/16 °C)	*P*-value (10/16 °C)
CO_2	AL1	1903.24 ± 598.09	306.42 ± 96.29	a	2817.22 ± 1095.89	453.57 ± 176.44	a	0.158	3902.70 ± 365.05	628.33 ± 58.77	**a**	**0.005****	0.158
	AL2	1051.43 ± 519.50	169.28 ± 83.64	a	1611.81 ± 807.17	259.5 ± 129.95	a	0.300	3437.45 ± 1412.73	553.43 ± 227.45	**ab**	**0.015***	0.057
	AL3	1078.51 ± 452.29	173.64 ± 72.82	a	1422.87 ± 515.92	229.08 ± 83.06	a	0.331	2819.71 ± 184.49	453.97 ± 29.70	**ab**	**0.003****	**0.007****
	PFI	1444.11 ± 217.26	232.5 ± 34.98	a	1276.32 ± 525.11	205.49 ± 84.54	a	0.441	2239.26 ± 508.46	360.52 ± 81.86	**b**	**0.028***	**0.045***
	PFT	2594.77 ± 1480.05	417.76 ± 238.29	a	2003.33 ± 359.50	322.54 ± 57.88	a	0.581	2805.41 ± 610.18	451.67 ± 98.24	**ab**	0.573	0.065
	Mean	1614.41 ± 915.38	259.92 ± 147.38		1826.31 ± 848.18	294.04 ± 136.56			3040.91 ± 887.63	489.59 ± 142.91			
CH_4	AL1	0.03 ± 0.06	0.01 ± 0.01	a	0.05 ± 0.09	0.01 ± 0.01	a	0.850	0.06 ± 0.06	0.01 ± 0.01	a	0.139	0.237
	AL2	0.16 ± 0.27	0.03 ± 0.04	a	0.12 ± 0.14	0.02 ± 0.02	a	1.000	0.13 ± 0.13	0.02 ± 0.02	a	0.561	0.561
	AL3	0.16 ± 0.20	0.03 ± 0.03	a	0.00 ± 0.00	0.00 ± 0.00	a	0.131	0.15 ± 0.14	0.02 ± 0.02	a	0.772	**0.014***
	PFI	0.06 ± 0.11	0.01 ± 0.02	a	0.06 ± 0.13	0.01 ± 0.02	a	0.850	0.16 ± 0.10	0.03 ± 0.02	a	0.139	0.139
	PFT	0.00 ± 0.00	0.00 ± 0.00	a	0.15 ± 0.31	0.02 ± 0.05	a	0.317	0.38 ± 0.42	0.06 ± 0.07	a	**0.014***	0.139
	Mean	0.08 ± 0.16	0.01 ± 0.03		0.08 ± 0.16	0.01 ± 0.03			0.18 ± 0.22	0.03 ± 0.04			

Table S6: Daily rates and cumulative anaerobic N_2O production a) and maximum hourly N_2O production rates b) detected during the incubation period of 161 days (mean ± standard deviation, n = 4). N_2O production differences by peat layer (One-way ANOVA and Tukey's HSD / Kruskal-Wallis and Dunn's test) are indicated with grouping letters (a, ab, b). Significant *P*-values (One-way ANOVA / Kruskal-Wallis) of N_2O gas production between incubation temperatures are indicated with bold letters and asterisks. Level of significance: * significant at $P \leq 0.001$, **significant at $P \leq 0.01$, *significant at $P \leq 0.05$.**

Incubation temperature		4 °C			10 °C				16 °C				
GHG	Peat layer	Production rate (µg N kg^{-1} dry weight day^{-1})	Cumulative production (mg N kg^{-1} dry weight)	Peat layer groups	Production rate (µg N kg^{-1} dry weight day^{-1})	Cumulative production (mg N kg^{-1} dry weight)	Peat layer groups	*P*-value (4/10 °C)	Production rate (µg N kg^{-1} dry weight day^{-1})	Cumulative production (mg N kg^{-1} dry weight)	Peat layer groups	*P*-value (4/16 °C)	*P*-value (10/16 °C)
Anaerobic N_2O production (daily production rate and cumulative production)	AL1	8.55 ± 16.00	1.38 ± 2.58	a	5.37 ± 11.66	0.86 ± 1.88	a	0.387	-9.98 ± 18.15	-1.61 ± 2.92	a	**0.043***	0.149
	AL2	24.68 ± 27.94	3.97 ± 4.50	a	17.12 ± 32.14	2.76 ± 5.17	a	0.387	1.35 ± 13.11	0.22 ± 2.11	a	0.083	0.248
	AL3	22.36 ± 41.45	3.60 ± 6.67	a	13.88 ± 24.74	2.23 ± 3.98	a	1.000	2.44 ± 5.45	0.39 ± 0.88	a	0.387	0.564
	PFI	8.16 ± 16.12	1.31 ± 2.60	a	3.92 ± 8.06	0.63 ± 1.30	a	0.773	-2.10 ± 4.03	-0.34 ± 0.65	a	0.248	0.387
	PFT	-0.22 ± 0.18	-0.04 ± 0.03	a	-0.15 ± 0.33	-0.02 ± 0.05	a	0.773	0.00 ± 0.60	0.00 ± 0.10	a	0.773	0.564
	Mean	12.71 ± 23.85	2.05 ± 3.84		8.03 ± 18.31	1.29 ± 2.95			-1.66 ± 10.35	-0.27 ± 1.67			

Incubation temperature		4 °C		10 °C			16 °C			
GHG	Peat layer	Maximum production rate (µg N kg^{-1} dry weight $hour^{-1}$)	Peat layer groups	Maximum production rate (µg N kg^{-1} dry weight $hour^{-1}$)	Peat layer groups	*P*-value (4/10 °C)	Maximum production rate (µg N kg^{-1} dry weight $hour^{-1}$)	Peat layer groups	*P*-value (4/16 °C)	*P*-value (10/16 °C)
Anaerobic N_2O Maximum production rates (maximum hourly production rate)	AL1	4.82 ± 8.01	a	7.23 ± 13.79	a	0.554	0.05 ± 0.10	a	0.091	0.321
	AL2	8.12 ± 6.66	a	10.5 ± 16.62	a	0.663	5.50 ± 10.73	a	0.554	0.375
	AL3	7.75 ± 11.53	a	7.70 ± 12.38	a	0.885	9.00 ± 17.41	a	0.767	0.767
	PFI	5.32 ± 10.19	a	2.70 ± 5.20	a	0.758	0.15 ± 0.24	a	0.539	0.758
	PFT	0.03 ± 0.05	a	0.07 ± 0.15	a	0.850	0.15 ± 0.30	a	0.850	0.850
	Mean	5.21 ± 7.96		5.64 ± 10.80			2.97 ± 8.96			

Table S7: Net nitrogen mineralisation (N_{min}) µg and mg kg^{-1} dry weight day^{-1} and net nitrogen nitrification (N_{nitr}) rates in µg kg^{-1} dry weight day^{-1} (incubation period of 161 days) (mean ± standard deviation, n = 4). Rate differences by peat layer (determined with ANOVA and Tukey's HSD test or Kruskal-Wallis and Dunn test) are indicated with grouping letters (a, ab, b). Significant *P*-values of mineralisation and nitrification differences between incubation temperature, determined with ANOVA or Kruskal-Wallis test, are indicated with bold letters and asterisks. Level of significance: * significant at $P \leq 0.001$, **significant at $P \leq 0.01$, *significant at $P \leq 0.05$.**

	Incubation temperature	4 °C			10 °C				16 °C				
Process	Peat layer	Rate (µg kg^{-1} dry weight day^{-1})	Rate (mg kg^{-1} dry weight day^{-1})	Peat layer grouping	Rate (µg kg^{-1} dry weight day^{-1})	Rate (mg kg^{-1} dry weight day^{-1})	Peat layer grouping	*P*-value (4/10 °C)	Rate (µg kg^{-1} dry weight day^{-1})	Rate (mg kg^{-1} dry weight day^{-1})	Peat layer grouping	*P*-value (4/16 °C)	*P*-value (10/16 °C)
Aerobic net nitrogen mineralisation (N_{min} A)	AL1	323.10 ± 217.44	0.32 ± 0.22	a	396.90 ± 278.06	0.40 ± 0.28	**b**	0.705	751.82 ± 398.87	0.75 ± 0.40	**ab**	0.070	0.152
	AL2	253.40 ± 81.16	0.25 ± 0.08	a	453.12 ± 262.65	0.45 ± 26	**b**	0.138	692.18 ± 445.78	0.69 ± 0.45	**ab**	**0.029***	0.330
	AL3	315.90 ± 181.40	0.32 ± 0.18	a	477.35 ± 95.93	0.48 ± 0.10	**ab**	0.167	811.75 ± 248.66	0.81 ± 0.25	**ab**	**0.018***	**0.046***
	PFI	617.80 ± 390.56	0.62 ± 0.39	a	767.28 ± 378.63	0.77 ± 0.38	**ab**	0.602	482.80 ± 589.57	0.48 ± 0.59	**b**	0.716	0.448
	PFT	1177.67 ± 654.69	1.18 ± 0.65	a	1379.90 ± 652.17	1.38 ± 0.65	**a**	0.677	1674.95 ± 618.18	1.67 ± 0.62	**a**	0.312	0.536
	Mean	537.58 ± 479.69	0.54 ± 0.48		694.91 ± 505.17	0.69 ± 0.51			882.70 ± 599.66	0.88 ± 0.60			
Anaerobic net nitrogen mineralisation (N_{min} An)	AL1	80.17 ± 122.71	0.08 ± 0.12	**ab**	238.40 ± 170.12	0.24 ± 0.17	**b**	0.182	376.58 ± 202.61	0.38 ± 0.20	**ab**	**0.046***	0.336
	AL2	18.70 ± 30.15	0.02 ± 0.03	**b**	177.60 ± 79.18	0.18 ± 0.08	**b**	**0.023***	328.88 ± 96.72	0.33 ± 0.10	**ab**	**0.003****	0.052
	AL3	4.00 ± 42.86	0.00 ± 0.04	**b**	171.05 ± 44.45	0.17 ± 0.04	**b**	**0.002***	229.50 ± 119.54	0.23 ± 0.12	**b**	**0.012***	0.395
	PFI	110.38 ± 80.17	0.11 ± 0.08	**ab**	311.88 ± 116.90	0.31 ± 0.12	**ab**	**0.030***	262.98 ± 151.47	0.26 ± 0.15	**ab**	0.125	0.628
	PFT	431.65 ± 197.64	0.43 ± 0.20	**a**	668.90 ± 226.86	0.67 ± 0.23	**a**	0.166	692.50 ± 235.90	0.69 ± 0.24	**a**	0.141	0.890
	Mean	134.78 ± 192.16	0.13 ± 0.19		313.57 ± 228.24	0.31 ± 0.23			378.09 ± 226.68	0.38 ± 0.23			

Table S8: Net nitrogen nitrification (N_{nitr}) rates in µg kg^{-1} dry weight day^{-1} (incubation period of 161 days) (mean ± standard deviation, n = 4). Rate differences by peat layer (determined with ANOVA and Tukey's HSD test or Kruskal-Wallis and Dunn test) are indicated with grouping letters (a, ab, b). Significant *P*-values of mineralisation and nitrification differences between incubation temperature, determined with ANOVA or Kruskal-Wallis test, are indicated with bold letters and asterisks. Level of significance: * significant at $P \leq 0.001$, **significant at $P \leq 0.01$, *significant at $P \leq 0.05$.**

Incubation temperature		4 °C		10 °C			16 °C			
Process	Peat layer	Rate (µg kg^{-1} dry weight day^{-1})	Peat layer grouping	Rate (µg kg^{-1} dry weight day^{-1})	Peat layer grouping	*P*-value (4/10 °C)	Rate (µg kg^{-1} dry weight day^{-1})	Peat layer grouping	*P*-value (4/16 °C)	*P*-value (10/16 °C)
Aerobic net nitrogen nitrification (N_{nitr})	AL1	-33.33 ± 31.96	a	41.00 ± 107.41	a	0.248	96.58 ± 249.04	a	0.248	0.773
	AL2	-19.00 ± 16.49	a	81.95 ± 99.99	a	**0.043***	90.90 ± 116.45	a	0.059	1.000
	AL3	-9.05 ± 9.50	a	64.50 ± 104.05	a	**0.021***	93.20 ± 201.91	a	0.309	0.248
	PFI	-5.75 ± 4.76	a	247.70 ± 319.38	a	**0.021***	-2.62 ± 6.11	a	0.381	**0.021***
	PFT	-16.30 ± 19.91	a	35.00 ± 76.42	a	0.387	-13.07 ± 20.01	a	0.468	0.387
	Mean	-16.69 ± 19.53		94.03 ± 169.26			53.00 ± 145.10			

Table S9: Temperature coefficient (Q_{10}) and activation energy (E_a) calculated for CO_2 production ($Q_{10}CO_2$) and net nitrogen mineralisation ($Q_{10}N_{min}$) at aerobic and anaerobic incubation conditions (mean ± standard deviation, n = 4). Q_{10} differences by peat layer (determined with ANOVA and Tukey's HSD test or Kruskal-Wallis and Dunn test) are indicated with letters ($P \leq 0.05$).

Q_{10} of	Oxygen condition	Peat layer	Q_{10}	Peat layer grouping
CO_2 production (Q_{10} CO_2)	Aerobic	AL1	5.0 ± 0.9	**a**
		AL2	4.4 ± 0.5	**ab**
		AL3	4.2 ± 0.5	**ab**
		PFI	3.6 ± 0.7	**ab**
		PFT	2.9 ± 0.9	**b**
		Mean	4.0 ± 1.0	
CO_2 production (Q_{10} CO_2)	Anaerobic	AL1	1.9 ± 0.7	**ab**
		AL2	2.7 ± 1.0	**a**
		AL3	2.3 ± 0.5	**ab**
		PFI	1.5 ± 0.4	**ab**
		PFT	1.2 ± 0.5	**b**
		Mean	1.9 ± 0.8	
Nitrogen mineralisation (Q_{10} Nmin)	Aerobic	AL1	3.5 ± 1.5	**a**
		AL2	2.0 ± 0.4	**ab**
		AL3	2.5 ± 1.1	**ab**
		PFI	0.6 ± 0.4	**b**
		PFT	1.5 ± 0.3	**b**
		Mean	2.1 ± 1.3	
Nitrogen mineralisation (Q_{10} Nmin)	Anaerobic	AL1	2.9 ± 1.8	a
		AL2	3.1 ± 1.1	a
		AL3	1.7 ± 1.1	a
		PFI	1.1 ± 0.9	a
		PFT	1.3 ± 0.9	a
		Mean	2.0 ± 1.4	

500 **Table S10: Principal component loadings of the principal component analysis (PCA) of variables of the aerobic and**
501 **anaerobic incubation at 4 °C.**

Incubation temperature		4 °C						
Variable	**Abbreviation**	**PC1**	**PC2**	**PC3**	**PC4**	**PC5**	**PC6**	**PC7**
Aerobic cumulative CO_2-C (mg kg^{-1} DW)	Aerobic-CO2	-0.225	-0.086	0.116	-0.153	0.402	-0.149	0.245
Anaerobic cumulative CO_2-C (mg kg^{-1} DW)	Anaerobic-CO2	-0.224	0.127	0.224	-0.074	0.177	0.103	0.435
Aerobic cumulative CH_4-C (mg kg^{-1} DW)	Aerobic-CH4	-0.120	-0.126	-0.451	-0.043	0.088	0.135	-0.094
Anaerobic cumulative CH_4-C (mg kg^{-1} DW)	Anaerobic-CH4	0.144	-0.145	-0.074	-0.202	-0.227	0.275	0.273
Aerobic cumulative N_2O-N (mg kg^{-1} DW)	Aerobic-N2O	0.111	0.022	-0.268	-0.332	-0.204	-0.100	0.382
Anaerobic cumulative N_2O-N (mg kg^{-1} DW)	Anaerobic-N2O	0.162	-0.101	-0.312	-0.226	-0.101	0.080	0.101
Aerobic net N mineralisation (mg kg^{-1} DW d^{-1})	Aerobic-Nmin	-0.296	0.060	0.004	0.040	-0.268	0.004	-0.023
Anaerobic net N mineralisation (mg kg^{-1} DW d^{-1})	Anaerobic-Nmin	-0.284	-0.017	0.003	-0.087	-0.275	-0.037	-0.083
Aerobic net N nitrification (mg kg^{-1} DW d^{-1})	Aerobic-Nnit	-0.044	-0.392	-0.036	0.404	-0.022	0.009	0.130
Aerobic Q_{10} CO_2 production	Aerobic-Q10-CO2	0.247	0.218	0.036	0.148	-0.070	0.127	0.118
Anaerobic Q_{10} CO_2 production	Anaerobic-Q10-CO2	0.231	-0.076	-0.238	-0.146	-0.145	-0.310	0.027
Aerobic Q_{10} net N mineralisation	Aerobic-Q10-Nmin	0.156	0.182	0.302	-0.132	-0.023	0.123	0.262
Anaerobic Q_{10} net N mineralisation	Anaerobic-Q10-Nmin	0.165	0.250	0.084	-0.186	-0.092	0.221	-0.221
pH	pH	-0.185	-0.193	0.101	-0.335	0.257	-0.013	-0.308
Water filled pore space (%)	WFPS	-0.206	-0.240	-0.181	-0.274	0.019	0.076	-0.104
C (%)	C	0.024	0.190	-0.444	0.030	0.273	-0.224	0.028
N (%)	N	0.160	-0.289	0.255	-0.199	-0.100	-0.291	-0.096
C:N ratio	CN	-0.167	0.281	-0.290	0.203	0.068	0.174	0.149
C_{mic} (mg kg^{-1} DW)	Cmic	0.073	-0.351	0.046	-0.031	-0.176	0.476	0.062
DOC (mg kg^{-1} DW)	DOC	-0.250	-0.127	0.040	-0.226	0.152	0.015	0.339
Aromaticity (% DOC)	Arom.	0.241	-0.104	0.062	0.101	-0.024	-0.441	0.259
DN (mg kg^{-1} DW)	DN	-0.282	0.098	0.018	0.004	-0.326	-0.156	0.032
DON (mg kg^{-1} DW)	DON	-0.252	0.068	0.048	-0.032	-0.394	-0.250	-0.027
NH_4^+ (mg kg^{-1} DW)	NH4	-0.296	0.108	-0.028	0.073	-0.200	-0.009	0.116
NO_3^- (mg kg^{-1} DW)	NO3	0.044	0.392	0.036	-0.404	0.022	-0.009	-0.130
	% of variance	36.8	15.8	11.9	8.1	7.0	4.4	4.2
	% of variance sum				88.1			

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Table S11: Aerobic incubation: peat nutrient values before the incubation (initial) and at the end of the incubation period (n = 4). Statistical differences between initial contents and contents in the end of the incubation were determined via linear mixed effect model. Model results are shown in Table S13.

Incubation state	Incubation temperature (°C)	Peat layer (n = 4)	DOC (mg kg^{-1} DW)	C_{mic} (mg kg^{-1} DW)	DN (mg kg^{-1} DW)	DON (mg kg^{-1} DW)	NH_4^+-N (mg kg^{-1} DW)	NO_3^--N (mg kg^{-1} DW)	pH
Initial (before incubation)	-	AL1	854.91±186.67	710.84±295.45	166.15±94.46	131.03±82.80	29.76±16.87	5.37±5.14	3.70±0.21
		AL2	964.39±322.69	847.59±243.84	117.90±55.51	100.64±57.51	14.18±5.19	3.06±2.65	3.63±0.10
		AL3	838.28±142.91	1337.42±1022.90	140.73±77.32	111.21±58.84	28.05±19.20	1.46±1.53	3.87±0.28
		PFI	915.36±133.12	1275.78±707.56	177.68±81.34	103.09±31.03	73.64±49.97	0.93±0.77	4.23±0.53
		PFT	1525.34±481.89	§880.86±305.24	359.13±199.33	233.14±107.06	123.32±95.68	2.63±3.20	4.71±0.74
End of aerobic incubation	4 °C	AL1	771.83±245.45	983.73±140.85	162.69±94.53	76.90±53.97	87.14±47.93	0.00±0.00	3.41±0.20
		AL2	905.21±314.34	1030.21±217.99	118.29±37.18	60.23±27.11	58.04±14.15	0.00±0.00	3.42±0.06
		AL3	773.24±162.54	597.85±392.08	98.36±27.85	17.93±17.84	80.37±45.02	0.00±0.00	3.70±0.29
		PFI	844.88±138.44	393.96±448.73	153.13±114.19	1.96±3.92	174.03±112.16	0.00±0.00	4.18±0.51
		PFT	1235.09±357.56	923.20±446.02	280.48±180.05	0.39±0.77	315.55±199.63	0.00±0.00	4.38±0.69
	10 °C	AL1	949.29±267.26	784.35±286.42	170.46±114.39	72.27±360.93	87.06±61.30	11.97±15.86	3.44±0.18
		AL2	989.17±366.32	1125.64±397.31	140.87±85.82	50.63±46.18	73.94±32.46	16.26±15.44	3.49±0.15
		AL3	621.03±182.27	1730.60±455.61	88.77±21.45	2.03±4.06	94.52±48.00	11.84±16.20	3.71±0.26
		PFI	937.43±434.41	977.28±720.64	183.49±79.98	15.44±18.93	157.30±133.67	40.80±51.81	4.13±0.46
		PFT	819.99±436.70	1596.83±974.22	239.37±147.22	0.00±0.00	339.85±208.81	8.26±9.63	4.38±0.68
	16 °C	AL1	945.39±337.06	409.46±116.57	247.88±140.09	93.84±66.70	135.26±98.38	20.92±39.44	3.33±0.28
		AL2	1237.25±338.72	262.68±140.91	191.68±108.44	62.89±41.37	110.98±60.56	17.69±18.81	3.45±0.16
		AL3	994.93±249.51	150.46±160.61	180.55±42.23	23.99±27.73	143.75±74.60	16.46±31.92	3.64±0.25
		PFI	1051.44±212.23	218.68±40.18	152.81±102.92	20.03±35.46	151.79±124.08	0.51±0.60	4.03±0.47
		PFT	1078.53±425.27	232.77±345.26	282.59±180.73	0.00±0.00	395.09±193.41	0.52±0.42	4.27±0.64

Table S12: Anaerobic incubation: peat nutrient values before the incubation (initial) and at the end of the incubation period (n = 4). Statistical differences between initial contents and contents in the end of the incubation were determined via linear mixed effect model. Model results are shown in Table S13.

Incubation state	Incubation temperature (°C)	Peat layer (n = 4)	DOC (mg kg^{-1} DW)	C_{mic} (mg kg^{-1} DW)	DN (mg kg^{-1} DW)	DON (mg kg^{-1} DW)	NH_4^+-N (mg kg^{-1} DW)	NO_3^--N (mg kg^{-1} DW)	pH
Initial (before incubation)	-	AL1	854.91±186.67	710.84±295.45	166.15±94.46	131.03±82.80	29.76±16.87	5.37±5.14	3.70±0.21
		AL2	964.39±322.69	847.59±243.84	117.90±55.51	100.64±57.51	14.18±5.19	3.06±2.65	3.63±0.10
		AL3	838.28±142.91	1337.42±1022.90	140.73±77.32	111.21±58.84	28.05±19.20	1.46±1.53	3.87±0.28
		PFI	915.36±133.12	1275.78±707.56	177.68±81.34	103.09±31.03	73.64±49.97	0.93±0.77	4.23±0.53
		PFT	1525.34±481.89	880.86±305.24	359.13±199.33	233.14±107.06	123.32±95.68	2.63±3.20	4.71±0.74
End of anaerobic incubation	4 °C	AL1	1005.53±432.14	649.98±509.92	181.95±109.40	133.83±79.18	47.75±31.42	0.29±0.21	3.73±0.09
		AL2	1305.93±436.43	1001.45±705.38	134.39±52.07	112.37±49.39	21.85±4.30	0.24±0.07	3.73±0.10
		AL3	1101.77±136.02	1156.12±1507.84	113.45±36.72	83.30±25.22	29.98±18.56	0.18±0.24	3.90±0.30
		PFI	1259.23±238.91	613.00±76.93	202.71±112.43	110.30±60.14	92.14±57.72	0.20±0.16	4.52±0.57
		PFT	1762.19±575.23	498.16±245.10	369.78±236.71	174.24±126.41	195.03±124.25	0.41±0.46	4.72±0.74
	10 °C	AL1	1206.81±567.85	1765.71±569.51	205.90±126.99	132.33±88.97	69.84±37.48	3.67±4.17	3.60±0.12
		AL2	1456.21±553.44	1640.88±1064.92	136.64±72.90	90.83±64.04	40.91±9.99	4.92±4.73	3.52±0.04
		AL3	912.63±242.71	1302.86±444.08	82.64±47.12	28.68±31.41	48.88±20.11	8.18±2.87	3.71±0.19
		PFI	823.23±409.04	1614.34±1051.92	138.74±95.12	25.70±22.52	116.06±63.94	8.72±6.37	4.26±0.49
		PFT	1521.31±574.34	1505.40±1541.20	328.11±182.99	100.04±77.33	223.21±138.59	10.43±12.51	4.57±0.70
	16 °C	AL1	1585.84±574.86	2228.55±625.66	229.08±151.00	133.24±107.84	95.06±43.74	0.70±0.24	3.49±0.06
		AL2	1997.07±713.80	2472.46±1060.98	165.14±78.97	94.97±66.72	69.10±14.09	1.09±1.18	3.52±0.06
		AL3	1415.86±449.76	1507.23±903.69	87.12±37.27	24.16±23.17	65.65±15.90	0.81±0.32	4.06±0.19
		PFI	1167.11±421.48	916.65±582.69	152.25±26.51	13.77±19.32	116.56±61.05	0.35±0.66	4.31±0.42
		PFT	1656.47±735.95	936.44±706.23	299.36±182.04	69.61±76.43	236.44±120.49	0.99±0.97	4.76±0.74

Table S13: Linear mixed effects model estimates of fixed effects, SE, t-value, lower and upper confidence intervals and P-values of aerobic and anaerobic incubation initial (before incubation) and end values of analyzed nutrient concentrations.

Fixed effect	Estimate	SE	t-value	2.5% CI	97.5% CI	P-value	Significance
DOC aerobic							
(Intercept)	2.983	0.050	59.246	2.882	3.085	<0.001	***
End: aerobic	-0.042	0.035	-1.186	-0.113	0.029	0.241	
Incubation temperature: 10 °C	-0.026	0.043	-0.608	-0.113	0.060	0.546	
Incubation temperature: 16 °C	0.036	0.043	0.841	-0.050	0.123	0.405	
Peat layer: AL2	0.008	0.056	0.148	-0.104	0.120	0.883	
Peat layer: AL3	-0.079	0.056	-1.426	-0.191	0.032	0.160	
Peat layer: PFI	0.002	0.056	0.036	-0.110	0.114	0.971	
Peat layer: PFT	0.079	0.056	1.418	-0.033	0.191	0.162	
DOC anaerobic							
(Intercept)	2.981	0.056	53.585	2.870	3.093	<0.001	***
End: anaerobic	0.117	0.038	3.082	0.041	0.194	0.003	**
Incubation temperature: 10 °C	-0.013	0.046	-0.279	-0.106	0.080	0.782	
Incubation temperature: 16 °C	0.043	0.046	0.938	-0.050	0.136	0.353	
Peat layer: AL2	0.039	0.060	0.649	-0.081	0.159	0.519	
Peat layer: AL3	-0.086	0.060	-1.436	-0.206	0.034	0.157	
Peat layer: PFI	-0.061	0.060	-1.025	-0.181	0.059	0.310	
Peat layer: PFT	0.094	0.060	1.578	-0.026	0.214	0.121	
C_{mic} aerobic							
(Intercept)	2.949	0.134	22.053	2.681	3.218	<0.001	***
End: aerobic	-0.214	0.086	-2.486	-0.387	-0.041	0.016	*
Incubation temperature: 10 °C	0.157	0.104	1.510	-0.052	0.366	0.137	
Incubation temperature: 16 °C	-0.265	0.104	-2.551	-0.474	-0.056	0.014	*
Peat layer: AL2	0.130	0.134	0.967	-0.140	0.400	0.338	
Peat layer: AL3	-0.039	0.134	-0.292	-0.309	0.231	0.772	
Peat layer: PFI	0.036	0.134	0.266	-0.234	0.305	0.791	
Peat layer: PFT	0.066	0.134	0.489	-0.204	0.335	0.627	
C_{mic} anaerobic							
(Intercept)	2.871	0.112	25.645	2.646	3.097	<0.001	***
End: anaerobic	0.077	0.080	0.970	-0.083	0.238	0.337	
Incubation temperature: 10 °C	0.112	0.098	1.136	-0.086	0.309	0.262	
Incubation temperature: 16 °C	0.091	0.098	0.922	-0.107	0.288	0.361	
Peat layer: AL2	0.108	0.125	0.860	-0.144	0.359	0.394	
Peat layer: AL3	0.046	0.125	0.367	-0.205	0.297	0.715	
Peat layer: PFI	0.024	0.128	0.190	-0.233	0.282	0.850	
Peat layer: PFT	-0.101	0.125	-0.805	-0.352	0.151	0.425	
DN aerobic							
(Intercept)	2.226	0.124	18.005	1.977	2.474	<0.001	***
End: aerobic	-0.017	0.053	-0.322	-0.122	0.089	0.748	
Incubation temperature: 10 °C	0.013	0.063	0.204	-0.114	0.140	0.839	
Incubation temperature: 16 °C	0.055	0.063	0.868	-0.072	0.182	0.389	
Peat layer: AL2	-0.193	0.081	-2.364	-0.356	-0.029	0.022	*
Peat layer: AL3	-0.214	0.081	-2.622	-0.377	-0.05	0.012	*
Peat layer: PFI	-0.123	0.081	-1.507	-0.286	0.041	0.138	
Peat layer: PFT	0.159	0.081	1.953	-0.005	0.323	0.056	
DN anaerobic							
(Intercept)	2.261	0.139	16.31	1.982	2.539	<0.001	***
End: anaerobic	-0.019	0.068	-0.281	-0.156	0.117	0.780	
Incubation temperature: 10 °C	-0.066	0.081	-0.815	-0.227	0.096	0.419	
Incubation temperature: 16 °C	-0.008	0.082	-0.093	-0.172	0.157	0.926	
Peat layer: AL2	-0.133	0.104	-1.281	-0.342	0.076	0.206	
Peat layer: AL3	-0.257	0.104	-2.477	-0.466	-0.049	0.017	*
Peat layer: PFI	-0.149	0.107	-1.396	-0.363	0.065	0.169	
Peat layer: PFT	0.221	0.104	2.124	0.012	0.430	0.039	*

Level of significance: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

512 **Table S13: continued**

Fixed effect	Estimate	SE	t-value	2.5% CI	97.5% CI	P-value	Significance
DON aerobic							
(Intercept)	2.592	0.199	13.031	2.193	2.992	<0.001	***
End: aerobic	-1.119	0.140	-7.993	-1.400	-0.838	<0.001	***
Incubation temperature: 10 °C	-0.076	0.171	-0.443	-0.420	0.268	0.659	
Incubation temperature: 16 °C	-0.015	0.171	-0.090	-0.359	0.328	0.929	
Peat layer: AL2	-0.203	0.221	-0.921	-0.647	0.240	0.362	
Peat layer: AL3	-0.802	0.221	-3.630	-1.246	-0.358	<0.001	***
Peat layer: PFI	-0.772	0.221	-3.496	-1.216	-0.329	<0.001	***
Peat layer: PFT	-0.922	0.221	-4.176	-1.366	-0.479	<0.001	***
DON anaerobic							
(Intercept)	2.394	0.186	12.889	2.021	2.768	<0.001	***
End: anaerobic	-0.316	0.114	-2.773	-0.545	-0.087	0.008	**
Incubation temperature: 10 °C	-0.237	0.136	-1.747	-0.509	0.036	0.087	
Incubation temperature: 16 °C	-0.246	0.138	-1.791	-0.523	0.030	0.079	
Peat layer: AL2	-0.106	0.175	-0.608	-0.458	0.245	0.546	
Peat layer: AL3	-0.515	0.175	-2.945	-0.867	-0.164	0.005	**
Peat layer: PFI	-0.423	0.179	-2.359	-0.783	-0.063	0.022	*
Peat layer: PFT	0.032	0.175	0.181	-0.32	0.383	0.857	
NH_4^+ aerobic							
(Intercept)	1.343	0.196	6.838	0.949	1.738	<0.001	***
End: aerobic	0.622	0.068	9.131	0.485	0.759	<0.001	***
Incubation temperature: 10 °C	0.034	0.082	0.418	-0.13	0.199	0.677	
Incubation temperature: 16 °C	0.093	0.082	1.139	-0.071	0.258	0.260	
Peat layer: AL2	-0.210	0.106	-1.986	-0.422	0.002	0.053	
Peat layer: AL3	-0.190	0.106	-1.799	-0.402	0.022	0.078	
Peat layer: PFI	0.272	0.106	2.576	0.060	0.484	0.013	*
Peat layer: PFT	0.407	0.106	3.849	0.195	0.619	<0.001	***
NH_4^+ anaerobic							
(Intercept)	1.307	0.189	6.907	0.927	1.687	<0.001	***
End: anaerobic	0.392	0.071	5.532	0.250	0.534	<0.001	***
Incubation temperature: 10 °C	0.090	0.085	1.057	-0.081	0.261	0.296	
Incubation temperature: 16 °C	0.137	0.085	1.614	-0.034	0.308	0.113	
Peat layer: AL2	-0.178	0.110	-1.617	-0.398	0.043	0.112	
Peat layer: AL3	-0.261	0.110	-2.372	-0.481	-0.040	0.022	*
Peat layer: PFI	0.286	0.110	2.605	0.066	0.507	0.012	*
Peat layer: PFT	0.429	0.110	3.902	0.208	0.650	<0.001	***
NO_3^- aerobic							
(Intercept)	0.458	0.125	3.665	0.207	0.709	<0.001	***
End: aerobic	0.019	0.085	0.221	-0.151	0.189	0.826	
Incubation temperature: 10 °C	0.399	0.103	3.888	0.193	0.605	<0.001	***
Incubation temperature: 16 °C	0.191	0.103	1.861	-0.015	0.397	0.069	
Peat layer: AL2	-0.178	0.133	-1.341	-0.444	0.089	0.186	
Peat layer: AL3	-0.394	0.133	-2.971	-0.66	-0.128	0.005	**
Peat layer: PFI	-0.223	0.133	-1.68	-0.489	0.044	0.099	
Peat layer: PFT	-0.561	0.133	-4.232	-0.827	-0.295	<0.001	***
NO_3^- anaerobic							
(Intercept)	0.556	0.103	5.410	0.350	0.763	<0.001	***
End: anaerobic	-0.027	0.073	-0.372	-0.173	0.119	0.712	
Incubation temperature: 10 °C	0.344	0.089	3.866	0.165	0.523	<0.001	***
Incubation temperature: 16 °C	0.088	0.089	0.984	-0.091	0.266	0.330	
Peat layer: AL2	-0.415	0.115	-3.608	-0.646	-0.184	<0.001	***
Peat layer: AL3	-0.311	0.115	-2.704	-0.542	-0.080	0.009	**
Peat layer: PFI	-0.282	0.115	-2.458	-0.513	-0.052	0.017	*
Peat layer: PFT	-0.529	0.115	-4.599	-0.759	-0.298	<0.001	***

Level of significance: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

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Fixed effect	Estimate	SE	t-value	2.5% CI	97.5% CI	P-value	Significance
pH aerobic							
(Intercept)	0.564	0.020	28.806	0.524	0.603	<0.001	***
End: aerobic	-0.014	0.006	-2.341	-0.026	-0.002	0.023	*
Incubation temperature: 10 °C	0.000	0.007	0.002	-0.015	0.015	0.999	
Incubation temperature: 16 °C	-0.003	0.007	-0.467	-0.018	0.011	0.642	
Peat layer: AL2	-0.009	0.009	-0.916	-0.027	0.010	0.364	
Peat layer: AL3	0.024	0.009	2.604	0.006	0.043	0.012	*
Peat layer: PFI	0.062	0.009	6.605	0.043	0.081	<0.001	***
Peat layer: PFT	0.099	0.009	10.493	0.080	0.117	<0.001	***
pH anaerobic							
(Intercept)	0.562	0.019	29.867	0.525	0.600	<0.001	***
End: anaerobic	0.008	0.007	1.104	-0.006	0.021	0.275	
Incubation temperature: 10 °C	-0.011	0.008	-1.358	-0.028	0.005	0.181	
Incubation temperature: 16 °C	-0.004	0.008	-0.506	-0.021	0.012	0.615	
Peat layer: AL2	-0.005	0.011	-0.439	-0.026	0.017	0.662	
Peat layer: AL3	0.027	0.011	2.582	0.006	0.049	0.013	*
Peat layer: PFI	0.070	0.011	6.597	0.049	0.091	<0.001	***
Peat layer: PFT	0.110	0.011	10.365	0.089	0.131	<0.001	***

Level of significance: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

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