Supplementary Information

Table S1. Specifics of the CARD-FISH probes applied.

Probe	Specificity	% Formamide in hybridization buffer	Probe sequence (5´-3´)	Publication
ANME-1-350	ANME-1	40%	AGT TTT CGC GCC TGATGC	(Boetius et al., 2000)
ANME-2-538	ANME-2	40%	GGC TAC CAC TCG GGC CGC	(Treude et al., 2005)
EUB338 I-III	Most bacteria	35%	GCT GCC TCC CGT AGG AGT GCA GCC ACC CGT AGG TGT GCT GCC ACC CGT AGG TGT	(Daims et al., 1999)
Ma450	Alpha-MOB	20%	ATC CAG GTA CCG TCA TTA TC	(Eller and Frenzel, 2001)
Mgamma84	Gamma-MOB	20%	CCA CTC GTC AGC GCC CGA	(Eller and Frenzel, 2001)
Mgamma705			CTG GTG TTC CTT CAG ATC	
NON338	Negative control	35%	ACT CCT ACG GGA GGC AGC	(Wallner et al., 1993)

Table S2. Experimental setups to quantify methane oxidation potential and the influence of different electron acceptors on methane oxidation.

Setup	Stock solution	Treatment	Conditions	Depths
dark	--	--	dark	3, 4, 5, 7 & 9 m
nitrate	5 mM 100 at.% $^{15}NO_3^-$	40 µM	dark	
nitrite	5 mM 100 at.% $^{15}NO_2^-$	20 µM	dark	
AQDS[1]	10 g l^{-1} AQDS	44 mg l^{-1}	dark	
light	--	--	light	3, 4 & 5 m
oxygen	saturated O_2 solution	15 µM	dark	
Humics[2]	2 g l^{-1} LHA	125 mg l^{-1}	dark	5, 7 & 9 m
Fe(III)	100 mM ferrihydrite suspension[3]	100 µM	dark	
Mn(IV)	100 mM birnessite suspension[4]	100 µM	dark	

[1]AQDS: anthraquinone-2,6-disulfonate (J&K Scientific)

[2]Leonardite Humic Acid Standard (purchased from the International Humic Substances Society)

[3]ferrihydrite was synthesized according to Cornell and Schwertmann (Cornell and Schwertmann, 2003)

[4]birnessite was synthesized according to Golden et al. (Golden et al., 1987)

Table S3. Methane oxidation rates as determined by linear regression analysis in the incubation experiments with substrate additions.

	Water column depth				
	3	4	5	7	9
Control (dark)	0.99 ±0.06	0.53 ±0.04	0.60 ±0.01	0.86 ±0.06	0.49 ±0.23
Light	3.87 ±0.06	0.86 ±0.03	0.55 ±0.02	-	-
Oxygen	1.79 ±0.22	0.64 ±0.08	0.59 ±0.01	-	-
AQDS	0.78 ±0.06	0.58 ±0.02	0.71 ±0.01	1.09 ±0.03	0.71 ±0.10
Leonardite humic acid	-	-	1.14 ±0.02	1.23 ±0.32	0.39 ±0.17
Mn(IV) (Birnessite)	-	-	0.48 ±0.04	0.69 ±0.14	0.65 ±0.22
Fe(III) (Ferrihydrite)	-	-	0.80 ±0.12	1.29 ±0.07	0.25 ±0.06
NO_2^-	0.94 ±0.02	0.38 ±0.02	0.41 ±0.04	1.54 ±0.11	0.24 ±0.06
NO_3^-	0.69 ±0.14	0.47 ±0.02	0.66 ±0.04	0.93 ±0.04	0.19 ±0.06

Fig. S1. Detailed view of dissolved oxygen (A) and PAR (B) profiles near the oxycline of Lake Lovojärvi. For full water column profiles, see Fig. 2.

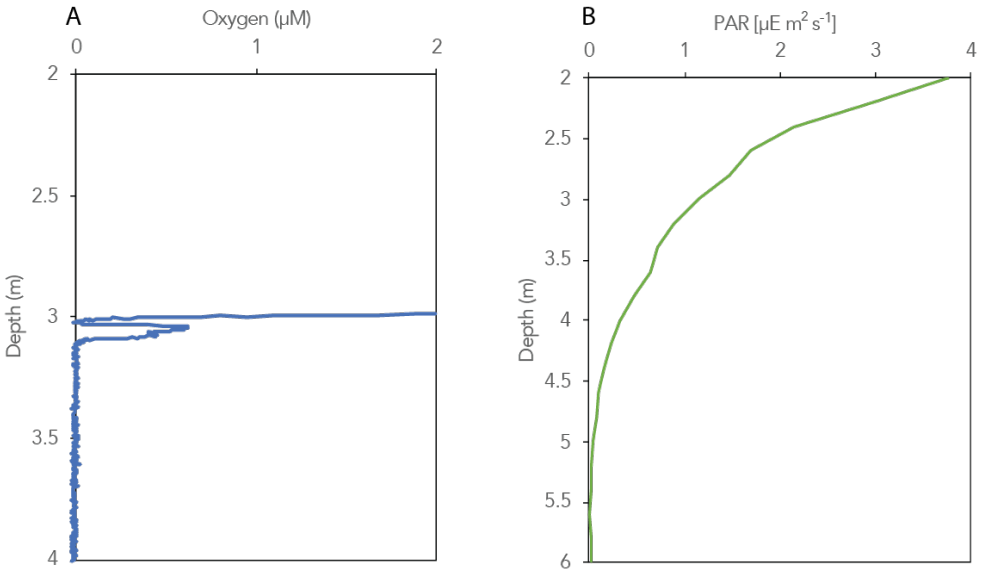


Fig. S2. Sulfate, sulfide (A), dissolved iron (B) and manganese (C) profiles of Lake Lovojärvi.

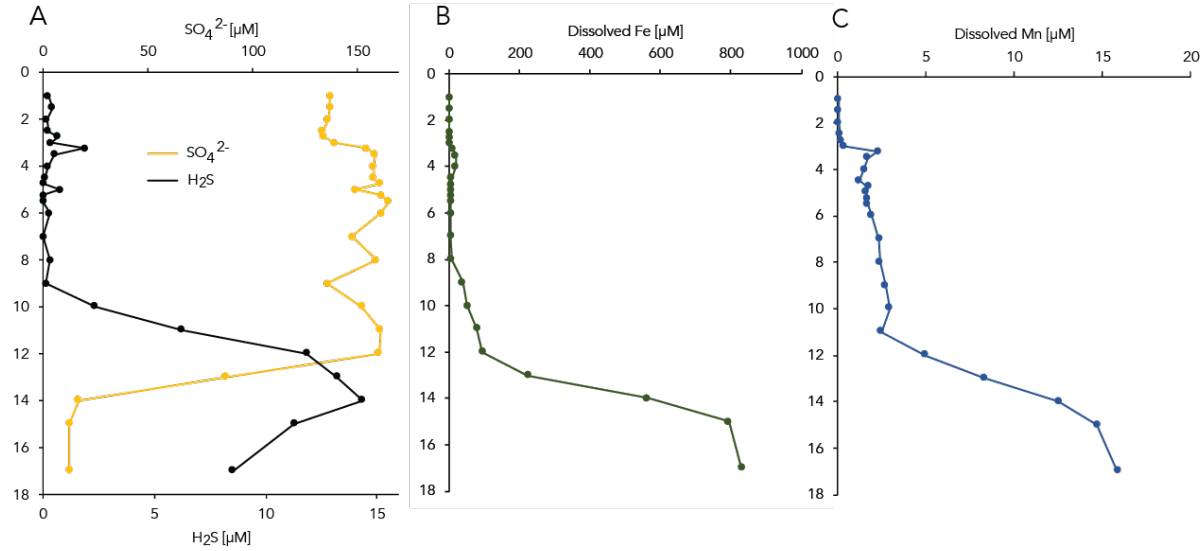


Fig. S3. Depth profiles of (A) DIC and δ^{13}C-DIC, (B) conductivity and turbidity and (C) pH. Note the scale of the pH x-axis starts at 6. DIC – Dissolved inorganic carbon.

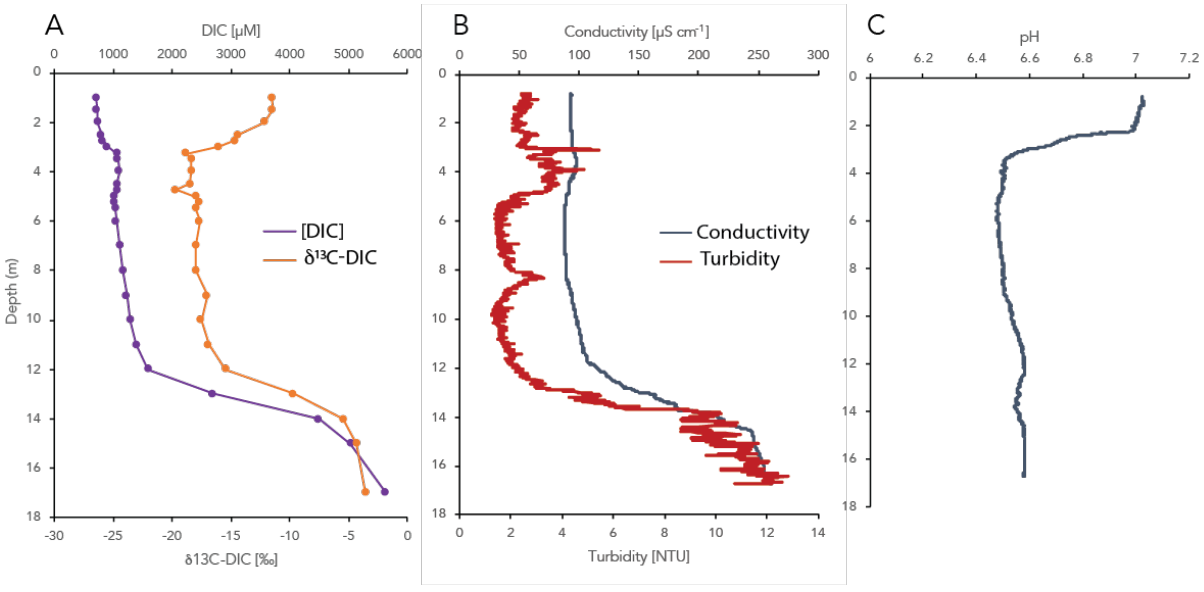
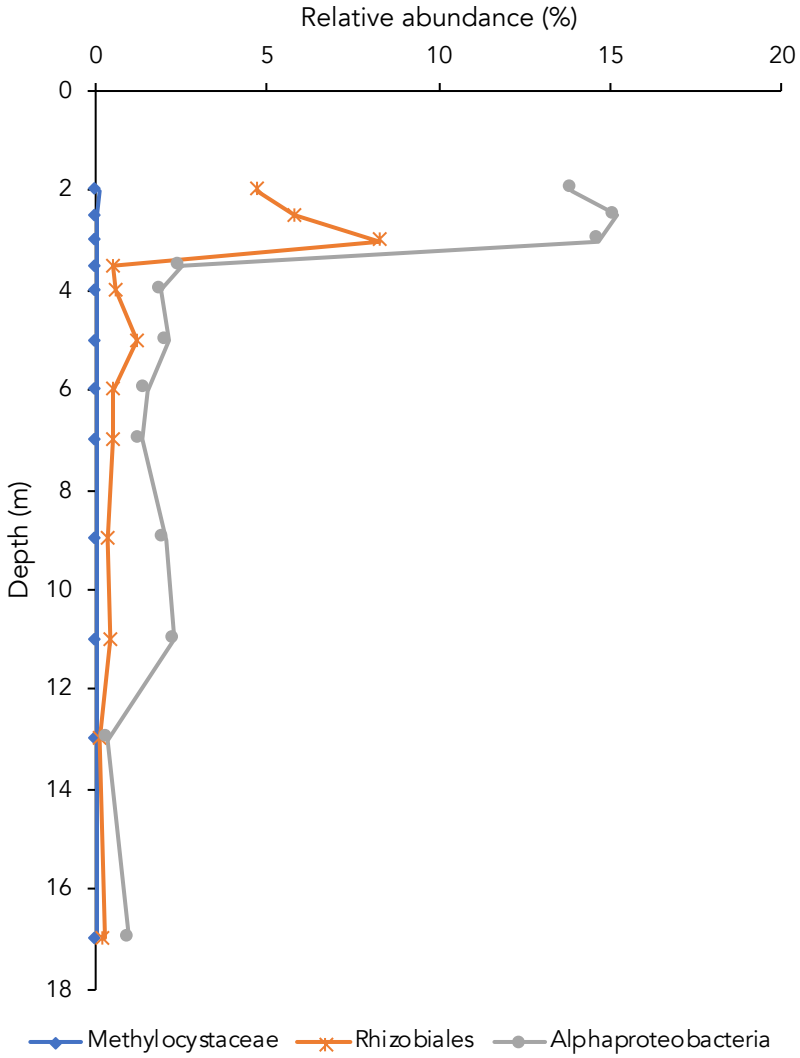


Fig. S4. Relative abundance of Alphaproteobacteria, Rhizobiales and *Methylocystaceae* reads according to 16S rRNA sequencing.


Relative abundance (%)
0
5
10
15
20
Depth (m)
0
2
4
6
8
10
12
14
16
18
Methylocystaceae
Rhizobiales
Alphaproteobacteria

26

27

28