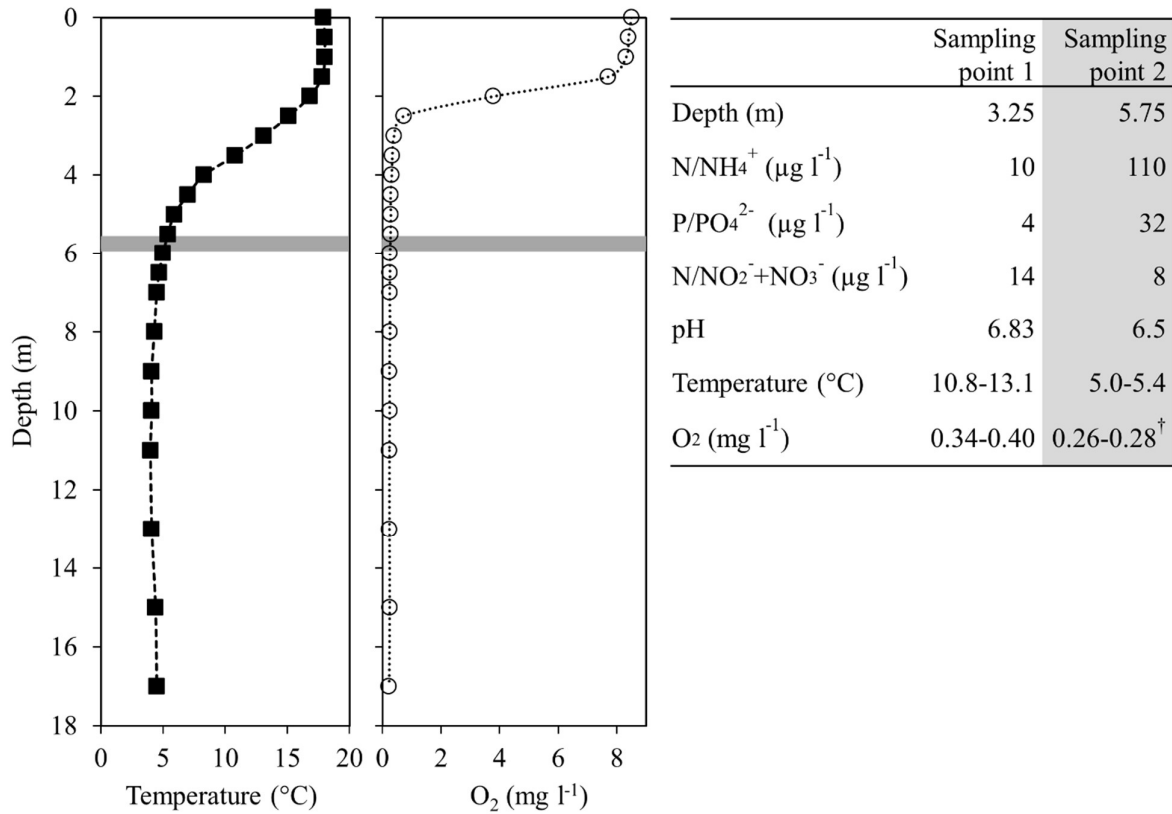


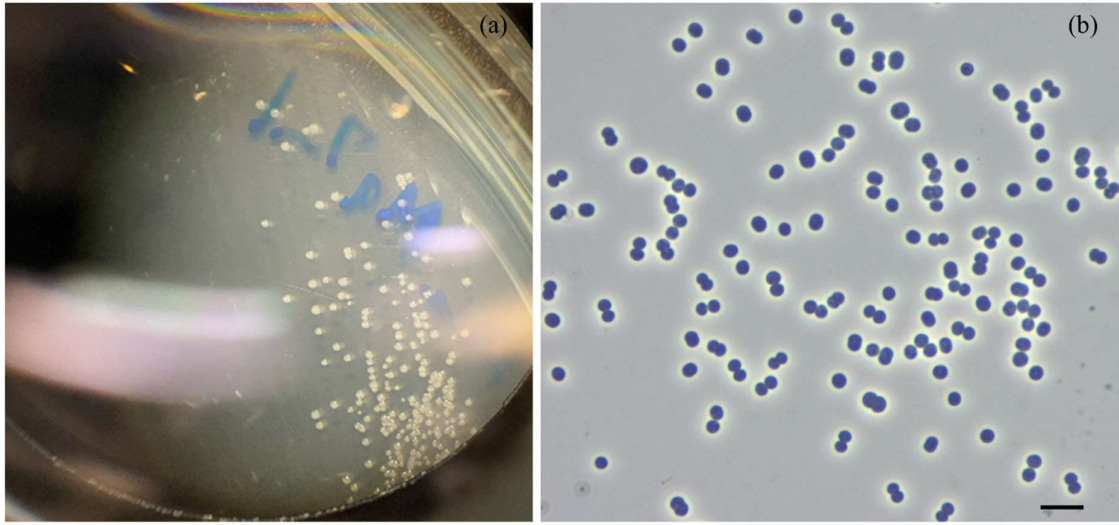
**Supplementary Information includes two files**

- 1. Supplementary Figures (.pdf) (included in this document)**
- 2. Supplementary Tables (.xlsx)**

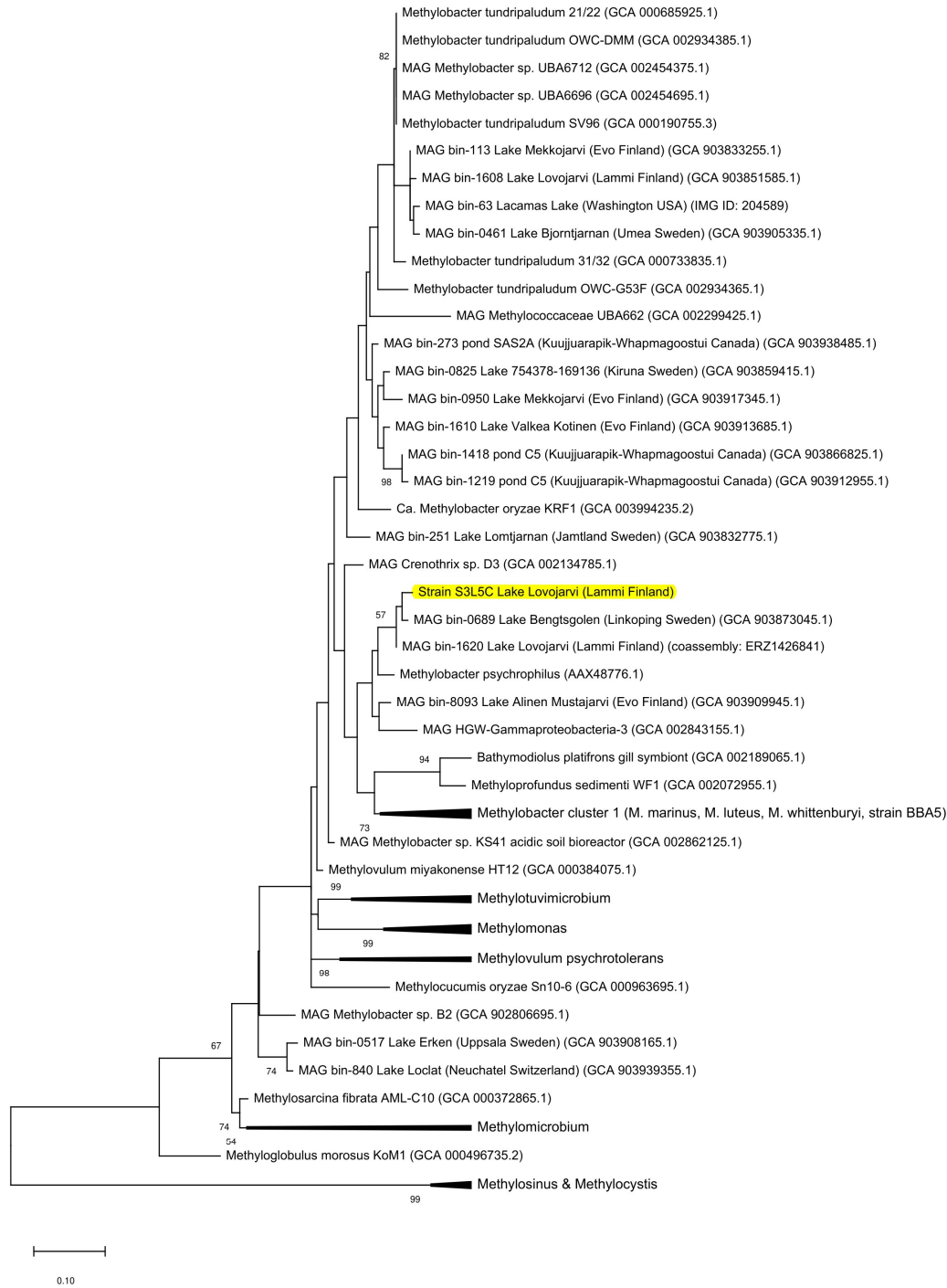
## Supplementary Figures



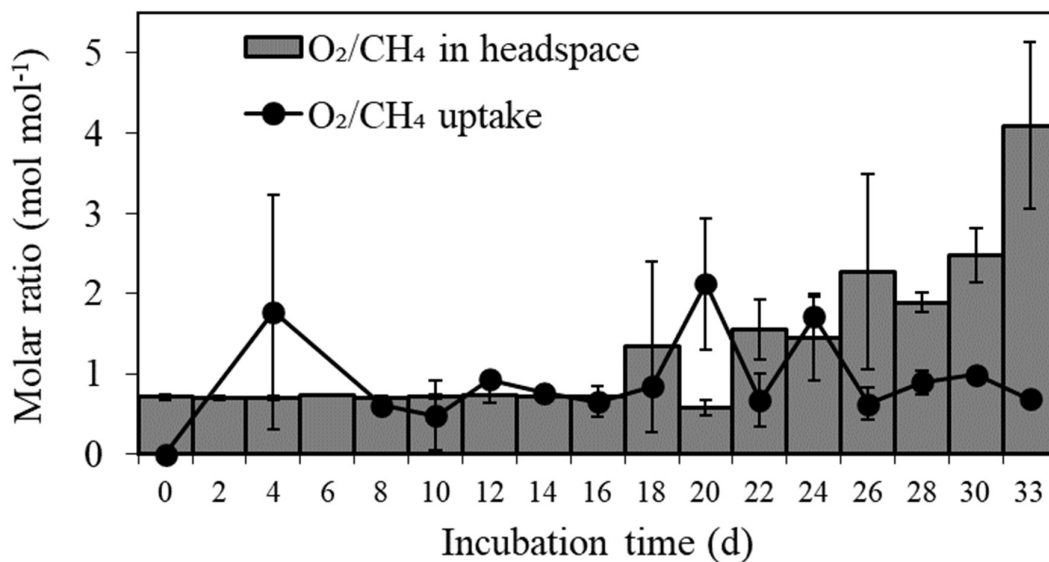
**Fig. S1.** Water column depth profiles of temperature and dissolved oxygen (DO) of Lake Lovojärvi and physicochemical characteristics of sampling points (on September 3, 2019). Gray highlights represent sampling points of lake water used for MOB enrichment. <sup>†</sup> The O<sub>2</sub>-measuring instrument (ProODO) has its lowest detection limit at around 0.3 mg l<sup>-1</sup>. Thus, the actual O<sub>2</sub> concentration is not known.



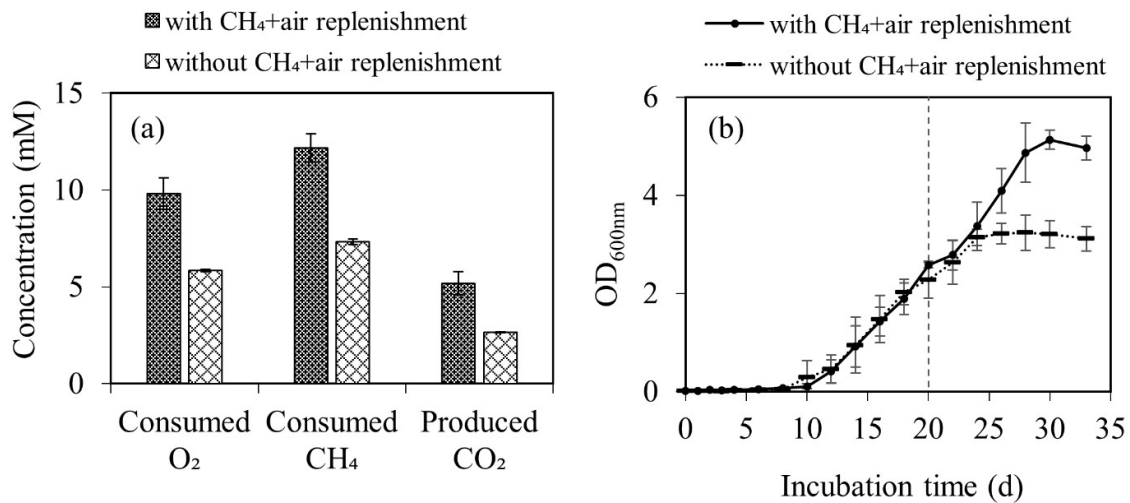
**Fig. S2.** (a) Photograph of *Methylobacter* sp. S3L5C colonies with a size of  $< 0.1$  mm diameter under a stereo microscope. (b) Phase-contrast light micrograph of cells of the strain S3L5C; bar, 5  $\mu\text{m}$ .



**Fig. S3.** Phylogenetic tree based on *pmoA* beta subunit genes of *Methylobacter* sp. S3L5C (highlighted in yellow) compared with other pure culture methanotrophic bacteria and metagenome-assembled genomes (MAG). GenBank accession numbers are given in parentheses, and the bar shows 10% sequence divergence.



**Fig. S4.** Profiles of oxygen-to-methane (O<sub>2</sub>/CH<sub>4</sub>) molar ratio in headspace and uptake during 33-day incubation in the batch tests with 20% CH<sub>4</sub> and 80% air replenishment on day 20. Error bars indicate the standard deviation of triplicate samples (See Supplemental Table S10 for dataset).



**Fig. S5.** (a) The consumed O<sub>2</sub> and CH<sub>4</sub> and produced CO<sub>2</sub> at the end of the test (day 33) and (b) biomass growth of *Methylobacter* sp. S3L5C during 33-day incubation between the tests with 20% CH<sub>4</sub> and 80% air replenishment on day 20 and the control without the replenishment.