**Supplementary Figure legends and supplementary table titles**

**Figure S1** Map of the Vestfold Hills showing Organic Lake.

**Figure S2** Bathymetry of Organic Lake 9 November 2008.

**Figure S3** Vertical profiles of physical and chemical parameters of Organic Lake taken *in situ* at the deepest point in the lake on 9 November 2008.

**Figure S4** Epifluorescence microscopy images of Organic Lake microbiota (<20 µm) filtered onto 0.01 µm polycarbonate membrane and stained with SYBR Gold.

**Figure S5** PCA analysis of physico-chemical parameters and cell/VLP counts of Organic Lake profile.

**Figure S6** Phylogenetic tree of rhodopsin homologs including proteorhodopsin, bacteriorhodopsin, actinorhodopsin and xanthorhodopsin.

**Figure S7** Genomic maps of Organic Lake scaffolds containing the OL-R1 rhodopsin homolog.

**Figure S8** Phylogenetic tree of DddD DMSP lyase homologs.

**Figure S9** Genomic maps of Organic Lake scaffolds containing the OL-dddD homolog.

**Figure S10** Phylogenetic tree of DddL DMSP lyase homologs from Organic Lake and public databases.

**Figure S11** Phylogenetic tree of DddP DMSP lyase homologs from Organic Lake and public databases.

**Figure S12** Phylogenetic tree of DmdA DMSP demethylase homologs from Organic Lake and public databases.

**Table S1** Summary of metagenomic data for Organic Lake samples.

**Table S2** Full list of KEGG Orthologs (KO) involved in carbon, nitrogen and sulfur conversions that were searched for in the Organic Lake metagenome.

**Table S3** Sequences used in this study as BLAST queries for retrieving homologs in the Organic Lake metagenomes.

**Table S4** Microbial taxa detected in the Organic Lake water column profile.

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