

## Supplementary Materials

*Biogeosciences*

### **Identify the core bacterial microbiome of hydrocarbon degradation and a shift of dominant methanogenesis pathways in oil and aqueous phases of petroleum reservoirs with different temperatures from China**

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## 1 Supplementary Data

### 1.1 Characterization of geographic properties of sampling reservoirs

Petroleum fluids samples were collected from eight sampling sites across China covering oilfields of different geological properties. The reservoir and crude oil properties together with the aqueous phase chemical concentration characteristics were listed in Table 1. P1 represents the sample collected from Zhan3-26 well located in Shengli Oilfield. Zhan3 block region in Shengli Oilfield is located in the coastal area from the Yellow River Estuary to the Bohai Sea. It is a medium-high temperature reservoir of fluvial face, made of a thin layer of crossed sand-mudstones, pebbled sandstones and fine sandstones. P2 represents the sample collected from Ba-51 well, which is located in Bayindulan reservoir layer of Erlian Basin, east Inner Mongolia Autonomous Region. It is a reservoir with highly heterogeneous layers, high crude oil viscosity and low formation fluid temperature. It was dedicated to water-flooding, however, due to low permeability and high viscosity of crude oil, displacement efficiency of water-flooding driving process was slowed down along the increase of water-cut rate. P3 and P4 represents samples which were collected from Liuzhong and Qixi blocks from Karamay Oilfield which located about 30 km to the east of Karamay City. Liuzhong reservoir is located in a piedmont diluvial fan deposit area mainly consisted of conglomerates and uneven gravel bearing sandstones, and is characterized as a reservoir of moderate porosity, high permeability, high crude oil viscosity and high heterogeneity. The reservoir region is distributed in a triangle fault block surrounded by Karamay-Wuerhe fracture belt and northern Baijiantan fracture belt. Qixi reservoir is located at footwall of Baijiantan fracture belt and is characterized as a heterogeneous conglomerate reservoir containing complex pore structures with low porosity and permeability. Both reservoirs from Karamay Oilfield were relatively low temperature reservoirs. P5 represents the sample collected from Wei5 block reservoir located in Gaoyou depression area of Subei Basin (Jiangsu Oilfield). It is a thin sand-mud interbed towards the front margin of a delta region, containing viscous crude oil. Due to its small volume, irregular reserve layers and relatively thin oil-bearing structure, it is difficult to further exploit using commonly applied methods. Many approaches have been carried out on this reservoir, such as cyclic steam stimulation, microorganism and water flood stimulation, etc. P6 represents the sample collected from Gao6 block reservoir located in the middle region of the western slope of Jinhu depression area of Subei Basin. This is a small and thin interbedded reservoir with moderate porosity, low permeability and high inter- and intralayer heterogeneity. P7 represents the sample collected from Xing4 block from Xingbei Oilfield, located in Daqing City. The main reservoir layer is made of lake sedimentary clastic rocks, composed of feldspars and quartz sandstones. The sandstones consist of over half fine sands, second by silty sands, and then medium fine sands. This reservoir is a reservoir comprised of multiple and thin layers, characterized with high porosity and low permeability property. P8 represents the sample collected from Qinying area located in Yangcun fault block. This sampling reservoir is from south part of Jinhu depression area of Subei Basin, and is a newly developed reservoir subjected to production test since 2012. P6 and P8 were both collected from Jinhu depression area from Jiangsu Oilfield and the *in situ* temperatures were higher than rest samples.

### 1.2 Reservoir geophysical properties and physicochemical properties

Reservoir geophysical properties and ion concentrations of aqueous phase samples were shown in Table 1. The physicochemical properties from P1-P4 aqueous phase samples were derived from the previous work (Wang et al. 2012). P1-P6 samples consist of aqueous and oil phases, while P7 only contains aqueous phase sample and P8 only contains oil phase. P3 and P4 are grouped into low temperature samples; P1, P2, P5 and P7 are grouped into moderate temperature samples; P6 and P8 are characterized as high temperature samples. Meanwhile, P1-P4 samples were pH neutral, P5-P8

samples were slightly alkaline. The reservoir general properties, including depth, temperature, pH, effective porosity, average permeability, and crude oil viscosity, were measured by local oilfield management agencies while sampling. All the reservoirs were operated by water flooding for years, aiming to enhance oil recovery efficiency, except for P8, located at Qinying block, Jiangsu Oilfield, a newly exploited site; so that no aqueous phase sample could be extracted from P8 oil-water fluids. Due to very less oil phase sample extracted from oil-water fluids from Xing4 block, Daqing (Xingbei) Oilfield, P7 sample also only contains aqueous phase. The effective porosity indicates percentage of effective interconnected pore space (excluding the porosity which could not benefit connections between pores) in the total volume of rocks, which could facilitate fluids flowing through rocks or sediments. It is an important parameter indicating pore property of reservoirs, reflecting the formation degree and connectivity of a certain reservoir. Average permeability is a measure of general ability of fluids flowing through reservoir layers to the oilwell. Oil viscosity reflects property and composition of crude oil. In general, crude oil with higher oil viscosity means higher content of asphaltenes and resins, and also higher content of long carbon chain hydrocarbons.

### 1.3 Diversity of microbial 16S rRNA gene through MiSeq sequencing

To obtain microbial composition structure from 14 aqueous and oil phase samples, we separately amplified prokaryotic and archaeal 16S rRNA gene from DNA samples. Although, archaeal 16S rRNA gene products could also be amplified from the prokaryotic 16S rRNA gene targeting primer pair, quantities of obtained sequences were limited and biased primers pairs could underestimate certain groups of archaea. Hence, in this study, we firstly sequenced the prokaryotic 16S rRNA gene, and then screened out the archaeal 16S rRNA gene and retained the bacterial 16S rRNA gene library. Finally, after subsampling to make all the library acquire even sequencing depth, each bacterial 16S rRNA gene library consisted of 6100 unique, dereplicated sequences, which through the analysis of QIIME pipeline could achieve good coverage (Good's coverage value within 89.6 to 94.1%). Nevertheless, it might be for the reason that low specificity of archaeal 16S rRNA gene primer pair introduced erroneous amplification of non-archaeal sequence and microbial composition was dominated by bacteria, archaeal 16S rRNA gene profile reflected that the majorities of libraries were not archaeal sequences. Consequently, screening out non-archaeal sequences from each library was also conducted, and after sub-sampling, each archaeal 16S rRNA gene library consisted of 760 unique, dereplicated sequences, which through the analysis of QIIME pipeline could achieve Good's coverage values ranging from 93.8 to 98.4% (Table S1). To analyze composition of methanogens, archaeal 16S rRNA gene libraries were further screened to obtain methanogenic libraries with sequencing depth of 240 for each library, and Good's coverage values ranging from 90.5 to 98.4%. Alpha diversity pattern of bacterial, archaeal, methanogenic 16S rRNA gene libraries were summarized into Table S1. From Good's coverage values and rarefaction curves of observed species which have been analyzed through QIIME pipeline for the individual library, it was observed that the majority (generally over 90%) of underlying species were estimated to be covered. According to the alpha diversity values from bacterial, archaeal and methanogenic libraries, bacterial communities had the largest average Chao1, Shannon and Simpson index value (2043, 5.8, 0.9) while archaeal communities had the second largest average Chao1 value (109.9), methanogenic communities had the smallest average Chao1 value (56.2). Archaeal communities had the same level of average Shannon and Simpson values as methanogenic communities (2.6, 0.6; 2.3, 0.6). Whereas, in terms of coefficient of variation of the above three indices (standard deviation over average value), the bacterial community acquired lower variation level of the three indices (2.4%, 13.5%, 5.3%), while, the archaeal and methanogenic communities acquired higher variation level of the three indices (51.5%, 38.1%, 33%; 65.9%, 43.3%, 40.5%). It is indicative that even though archaeal/methanogenic communities of 14 aqueous and oil samples show lower diverse patterns than bacterial communities, their intra-sample variations are larger than those of bacterial communities.

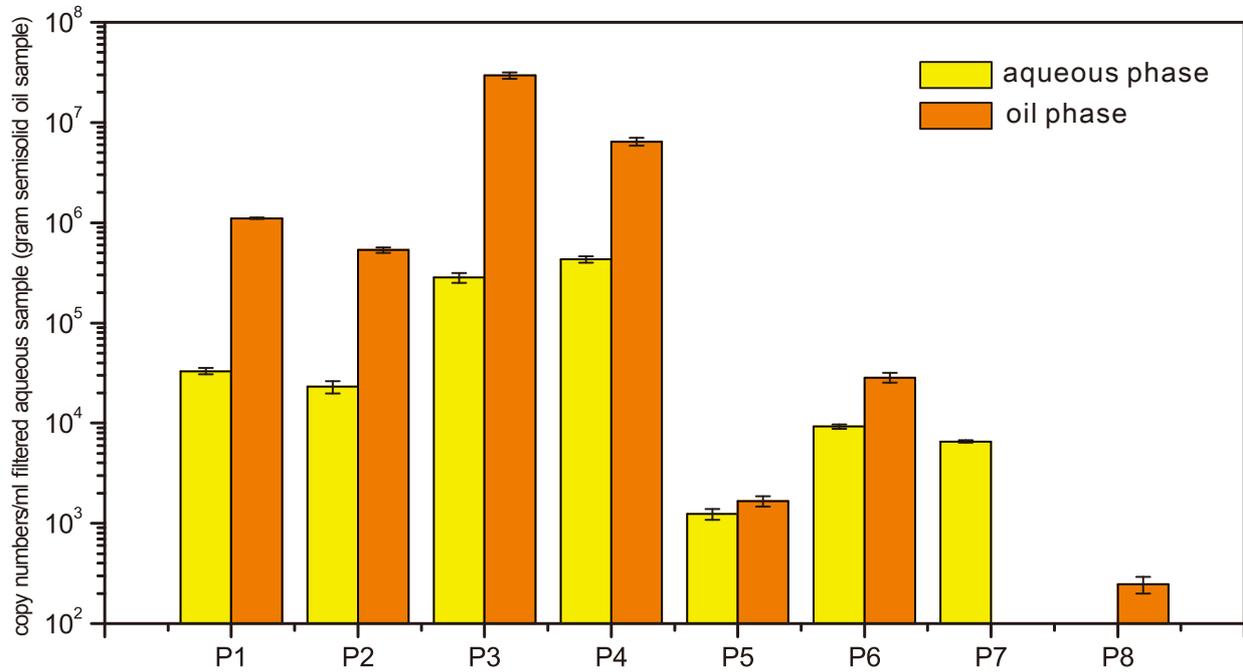
#### 1.4 Taxonomic and compositional profiles of microbial 16S rRNA gene through MiSeq sequencing

The open-reference OTU picking method implemented in QIIME assures that all sequences are divided into genus level OTUs with the guidance of genus level reference sequences, thus offers an exhaustive OTU classification (Rideout et al. 2014). Average bacterial sequences unclassified into known genera could account for 31.91%; and average archaeal sequences unclassified into known genera could account for 9.59%, while the percentage of average methanogenic sequences unclassified into known genera was even as low as 0.38% (Table S2). Taxonomic compositional profiles of 14 aqueous and oil phase samples revealed that on the genus level, 931 bacterial genera and 56 archaeal genera were obtained among all the samples. There were 36 bacterial genera with average abundance percentage over 0.5% amongst all the bacterial communities, and there were 14 archaeal genera with the average abundance percentage over 0.5% amongst all the archaeal communities. The most abundant five genera among bacterial communities were *Pseudomonas* (16.12%), *Acinetobacter* (9.94%), uncultured genus within *Hydrogenophilaceae* (5.44%), *Proteiniphilum* (3.06%) and *Marinobacter* (2.91%). The most abundant five genera among archaeal communities were *Methanosaeta* (42.3%), *Methanothermobacter* (9.69%), *Methanolobus* (9.07%), *Methanocalculus* (8.05%) and *Methanoculleus* (5.01%) (Table S3).

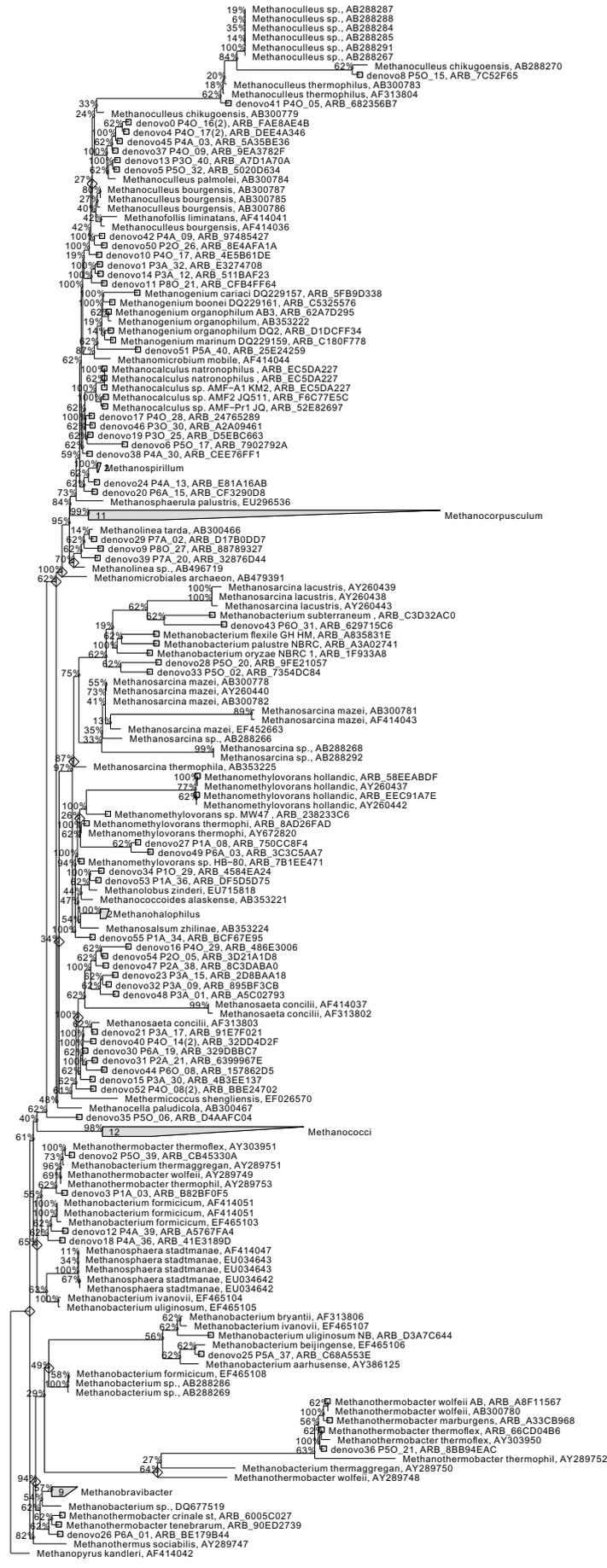
#### 1.5 Quantitation of *mcrA* gene abundance

Quantity units of *mcrA* gene abundance of aqueous and oil samples were gene copy numbers per microliter water sample and gene copy numbers per gram oil sample, respectively (Figure S1). The *mcrA* gene copies of all samples from this study varied substantially from  $2.5 \times 10^2$  copies/g in P8O to  $2.9 \times 10^7$  copies/g in P3O sample. The *mcrA* gene abundances in low temperature samples (P3 and P4) were the highest among all the samples in terms of both aqueous and oil phases, ranging from  $2.8 \times 10^5$  to  $4.3 \times 10^5$  copies/ml in aqueous phase, and  $6.4 \times 10^6$  to  $2.9 \times 10^7$  copies/g in oil phase. For moderate temperature samples (P1, P2, P5 and P7), the *mcrA* gene abundance among aqueous samples was ranging from  $1.2 \times 10^3$  copies/ml in P5A to  $3.3 \times 10^5$  copies/ml in P1A, while the highest *mcrA* gene abundance among oil samples was ranging from  $1.7 \times 10^3$  copies/g in P5O to  $1.1 \times 10^6$  copies/g in P1O. For high temperature samples (P6 and P8), the *mcrA* gene abundance of aqueous sample was  $9.2 \times 10^3$  copies/ml in P6A, and the *mcrA* gene abundance of oil samples was ranging from  $2.5 \times 10^2$  copies/g in P8O to  $2.8 \times 10^4$  copies/g in P6O. Within aqueous and oil phases of one individual sample, the numerical value of *mcrA* gene copy number in oil phase was generally one to two orders of magnitude larger than that in aqueous phase.

## 2 Supplementary Figures and Tables

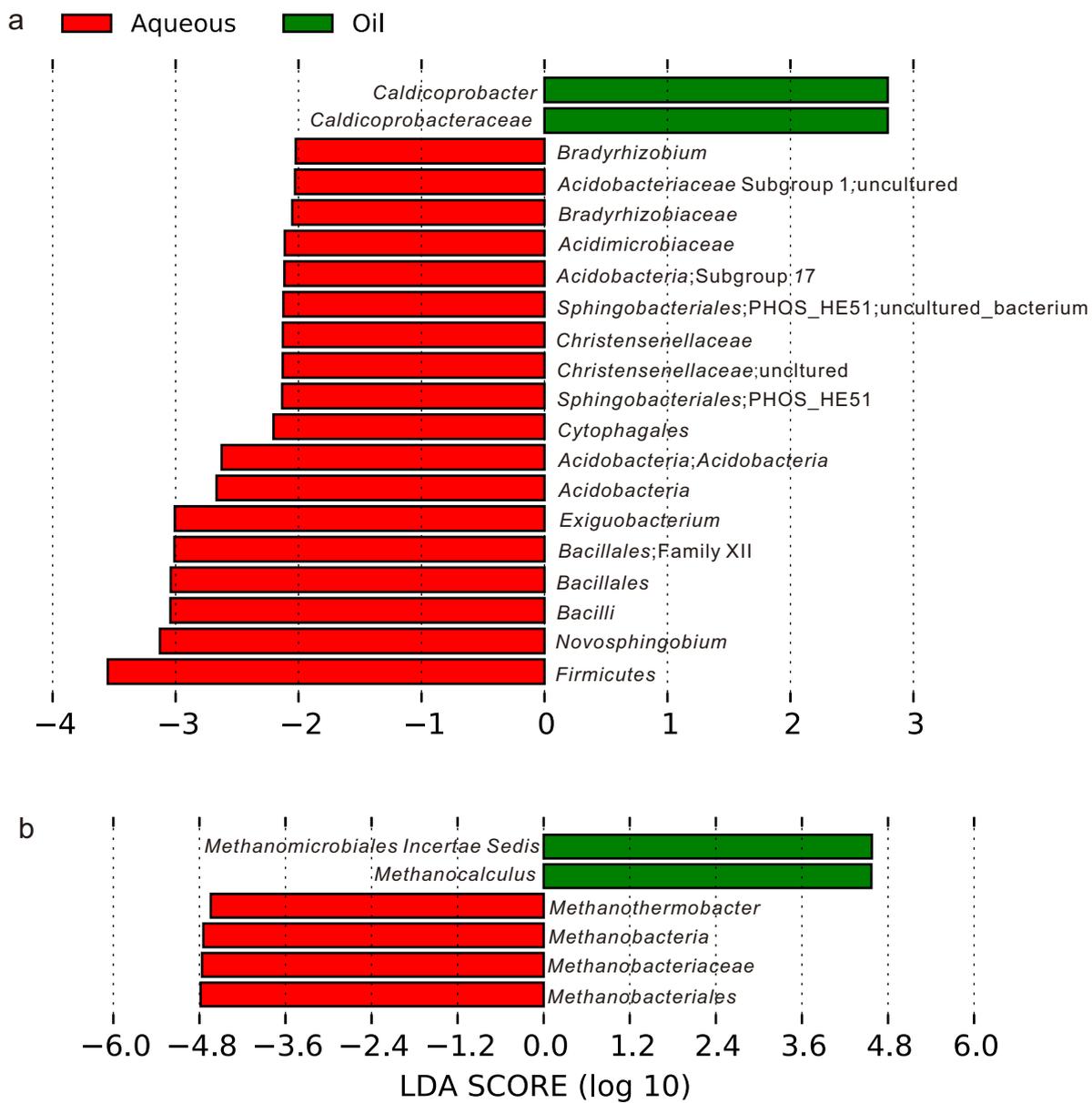


**Figure S1.** *mcrA* gene abundance of 14 aqueous and oil phase samples. Vertical coordinate was drawn in log-normalized label. The aqueous samples *mcrA* gene quantities were gene copy numbers/ml filtered aqueous sample; the oil samples *mcrA* gene quantities were gene copy numbers/gram semisolid oil sample.

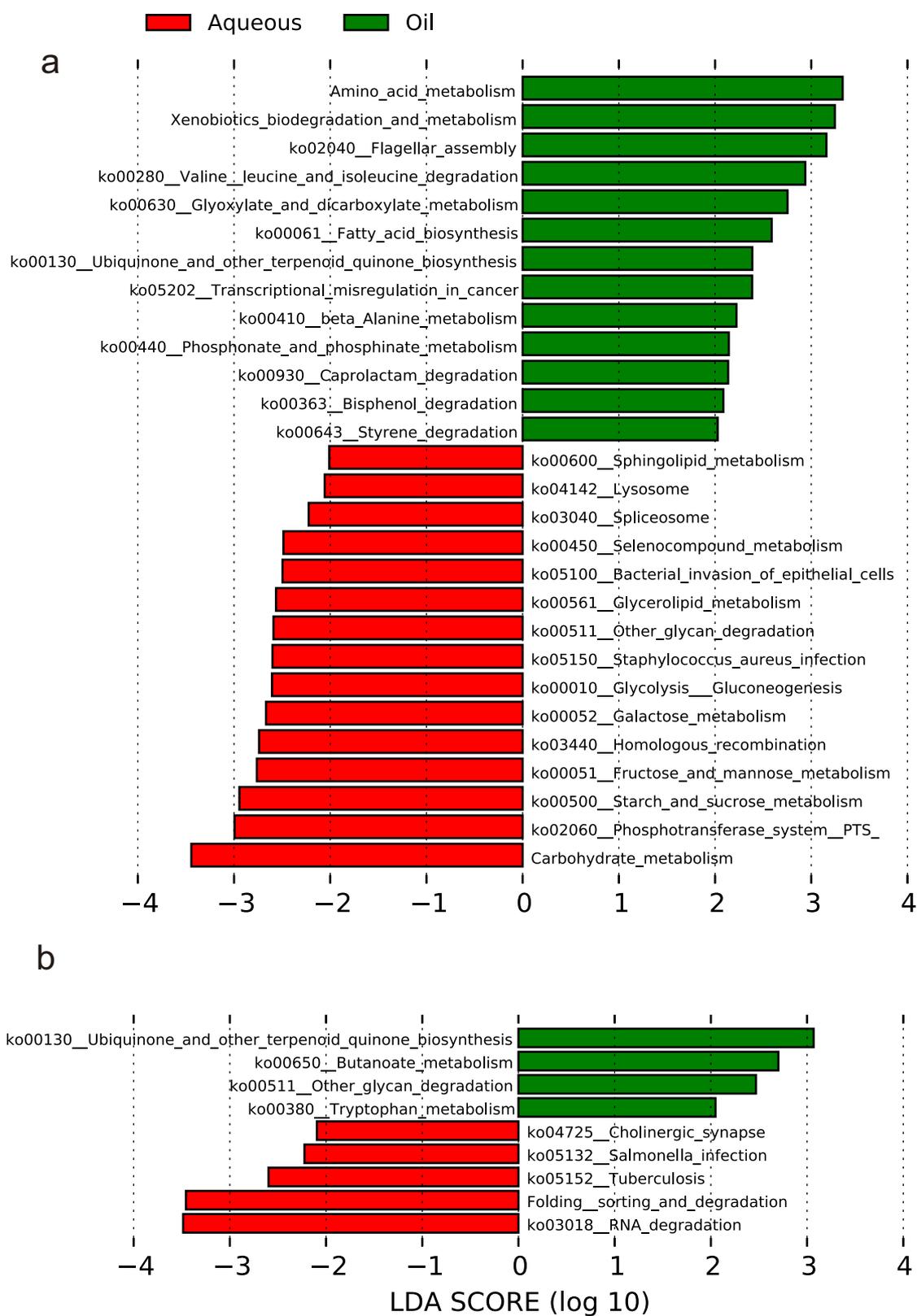


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**Figure S2.** Phylogenetic tree based on clone library *mcrA* gene and reference gene sequences. The OTU representative *mcrA* gene clone sequences were obtained by 0.05 cutoff on nucleotide level, and then inserted into *mcrA* gene ARB database by maximum parsimony method without changing the initial tree topology. (*mcrA* gene ARB database: <http://www.mpi-marburg.mpg.de/downloads/conrad/>)



**Figure S3.** Differentially distributed features of microbial taxon abundance in aqueous and oil phases. LEfSe analysis with LDA effect score was applied. (a) bacterial community feature; (b) archaeal community feature.



**Figure S4.** Differentially distributed feature of functional profiles in aqueous and oil phases. LefSe analysis results based on the predicted functional profiles by Tax4Fun. (a) bacterial community feature; (b) archaeal community feature.

**Table S1.** Alpha diversity values of aqueous and oil phase samples including bacterial, archaeal, methanogenic microorganism communities based on MiSeq archaeal 16S rRNA gene sequencing, methanogenic 16S rRNA gene clone library and *mcrA* gene clone library construction.

**Bacteria (MiSeq)**

SampleID	Seqs/Sample	PD whole tree	Chao1	Good's coverage	observed species	Shannon	Simpson
P1A	6100	39.222	1951.164	0.918	742.2	5.868	0.939
P1O	6100	32.782	1378.172	0.941	552.6	4.727	0.873
P2A	6100	39.311	2137.544	0.915	720.4	4.886	0.872
P2O	6100	36.549	1869.683	0.923	669.6	5.003	0.875
P3A	6100	50.028	2183.686	0.903	921.3	6.194	0.932
P3O	6100	48.894	2098.391	0.903	972.5	6.653	0.941
P4A	6100	43.85	2081.336	0.913	794.5	5.475	0.876
P4O	6100	45.632	2156.457	0.906	843.4	4.765	0.794
P5A	6100	45.792	2468.217	0.9	891.2	6.499	0.961
P5O	6100	36.263	2112.554	0.923	669.7	5.396	0.915
P6A	6100	39.937	2006.069	0.916	769.7	6.157	0.941
P6O	6100	40.756	2196.376	0.91	826.6	6.5	0.959
P7A	6100	49.66	2195.145	0.896	1032.6	7.2	0.969
P8O	6100	39.205	1767.685	0.924	726.8	5.73	0.924

**Archaea (MiSeq)**

SampleID	Seqs/Sample	PD whole tree	Chao1	Good's coverage	observed species	Shannon	Simpson
P1A	760	3.089	262.751	0.938	77.4	3.747	0.86
P1O	760	2.265	39.79	0.984	26.7	1.774	0.512
P2A	760	2.7	66.741	0.977	42.5	2.297	0.557
P2O	760	2.697	102.594	0.958	51.7	1.529	0.327
P3A	760	2.615	96.15	0.966	63	4.121	0.896
P3O	760	4.15	144.067	0.948	58.7	2.263	0.584
P4A	760	2.733	125.857	0.952	65.4	2.791	0.668
P4O	760	3.542	147.413	0.94	84.2	3.862	0.843
P5A	760	2.732	130.623	0.958	56.3	3.262	0.829
P5O	760	2.714	99.733	0.96	61.7	3.861	0.886
P6A	760	2.105	108.36	0.968	35.8	1.282	0.306
P6O	760	2.288	100.186	0.962	50	2.75	0.746
P7A	760	2.569	91.164	0.962	50.7	1.735	0.393
P8O	760	1.682	23.15	0.992	15.9	1.494	0.518

**Methanogen (MiSeq)**

SampleID	Seqs/Sample	PD whole tree	Chao1	Good's coverage	observed species	Shannon	Simpson
P1A	240	1.135	71.814	0.911	36.2	3.391	0.846
P1O	240	0.3	15.65	0.984	12.9	1.695	0.508
P2A	240	1.16	32.463	0.951	21.5	1.492	0.361
P2O	240	0.98	60.625	0.928	25.3	1.506	0.349
P3A	240	0.918	63.343	0.926	39.6	3.932	0.881
P3O	240	1.288	107.15	0.926	24.6	2.1	0.602
P4A	240	1.156	144.65	0.905	31.9	2.435	0.621
P4O	240	1.356	62.492	0.926	32.6	3.336	0.823
P5A	240	1.242	37.325	0.942	25.7	2.72	0.756
P5O	240	1.393	83.467	0.916	34	3.559	0.874
P6A	240	0.986	23.1	0.971	12.9	1.049	0.277
P6O	240	1.228	37.39	0.95	24	2.649	0.733
P7A	240	0.865	31.808	0.954	21.8	1.547	0.375
P8O	240	0.825	15.1	0.98	9.8	0.798	0.218

**Methanogen (Methanogenic 16S rRNA gene clone library)**

<b>SampleID</b>	<b>Seqs/Sample</b>	<b>PD whole tree</b>	<b>Chao1</b>	<b>Good's coverage</b>	<b>observed species</b>	<b>Shannon</b>	<b>Simpson</b>
P1A	28	1.167	8.5	0.893	7	2.132	0.689
P1O	28	1.101	10	0.857	7	1.84	0.589
P2A	28	0.997	7.5	0.929	7	2.277	0.724
P2O	28	0.415	6.333	0.929	6	1.698	0.554
P3A	28	0.337	8.333	0.929	8	2.564	0.781
P3O	28	0.305	3	0.964	3	1.139	0.503
P4A	28	0.519	12.5	0.821	10	2.52	0.717
P4O	28	0.472	6	1	6	2.296	0.758
P5A	28	1.314	13.333	0.821	10	2.846	0.827
P5O	28	0.472	4	1	4	1.662	0.64
P6A	28	1.078	5	0.964	5	1.67	0.582
P6O	28	1.051	13	0.857	7	2.032	0.671
P7A	28	0.238	2	1	2	0.592	0.245
P8O	28	1.267	8	0.929	7	2.503	0.801

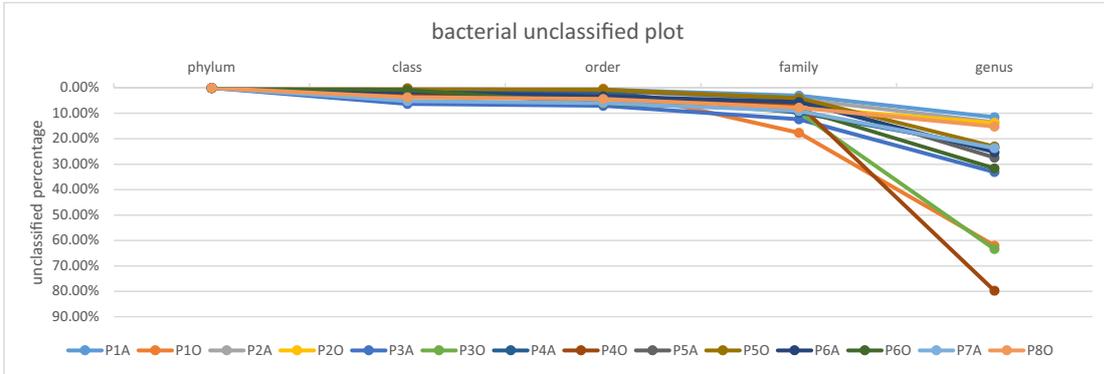
**Methanogen (*mcrA* gene clone library)**

<b>SampleID</b>	<b>Seqs/Sample</b>	<b>PD whole tree</b>	<b>Chao1</b>	<b>Good's coverage</b>	<b>observed species</b>	<b>Shannon</b>	<b>Simpson</b>
P1A	23	10	0.826	8	2.435	0.756	0.756
P1O	23	5	0.957	5	1.684	0.582	0.582
P2A	23	8	0.87	5	1.578	0.582	0.582
P2O	23	6	0.913	5	1.808	0.658	0.658
P3A	23	9.6	0.87	9	2.729	0.794	0.794
P3O	23	17	0.783	7	2.036	0.681	0.681
P4A	23	57	0.565	12	2.975	0.813	0.813
P4O	23	26	0.739	11	3.208	0.877	0.877
P5A	23	9	0.87	8	2.595	0.794	0.794
P5O	23	19	0.696	12	3.262	0.87	0.87
P6A	23	8	0.87	7	2.255	0.733	0.733
P6O	23	6.5	0.913	6	2.086	0.699	0.699
P7A	23	7.333	0.913	7	2.351	0.745	0.745
P8O	23	6.5	0.87	5	1.173	0.374	0.374

**Table S2.** Unclassified sequences percentage in each taxon level based on QIIME software applying SILVA compatible 119 release SSURef database as reference. a) bacterial community table and chart; b) archaeal community table and chart.

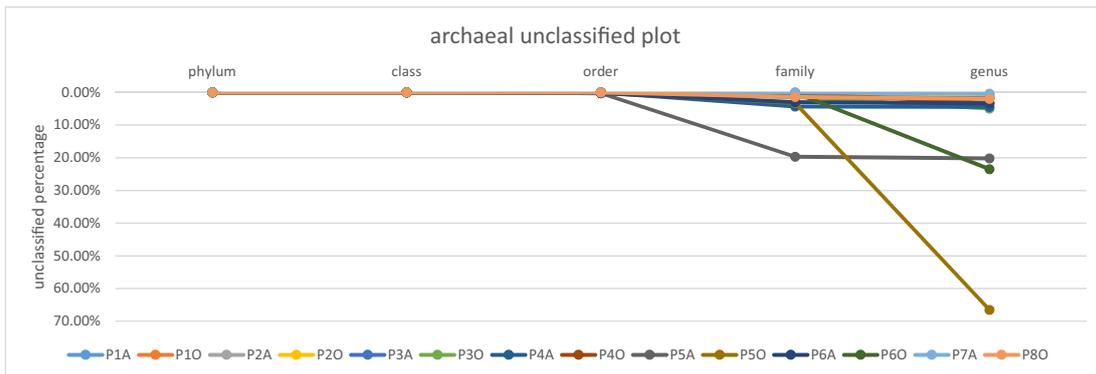
a

	P1A	P1O	P2A	P2O	P3A	P3O	P4A	P4O	P5A	P5O	P6A	P6O	P7A	P8O	average
phylum	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
class	0.38%	0.15%	0.44%	0.23%	6.32%	2.85%	1.43%	2.92%	0.41%	0.20%	1.67%	0.84%	5.18%	3.65%	1.90%
order	0.69%	0.29%	1.28%	5.59%	7.01%	4.05%	1.77%	3.24%	0.95%	0.70%	3.26%	6.19%	5.96%	4.34%	3.24%
family	3.06%	17.66%	4.39%	7.72%	12.37%	9.52%	9.71%	6.62%	4.16%	3.98%	5.52%	8.40%	9.11%	7.75%	7.86%
genus	11.53%	61.99%	13.50%	13.76%	33.08%	63.37%	23.53%	79.77%	27.42%	23.05%	25.29%	31.65%	23.69%	15.17%	31.91%

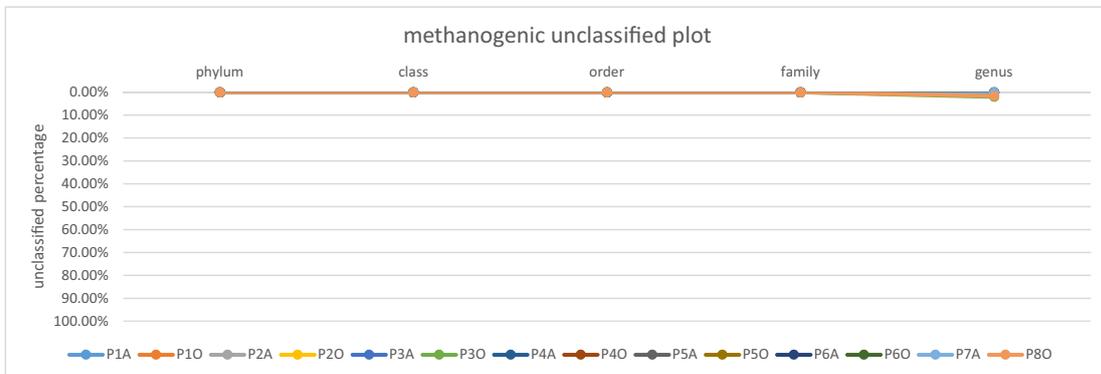


b

	P1A	P1O	P2A	P2O	P3A	P3O	P4A	P4O	P5A	P5O	P6A	P6O	P7A	P8O	average
phylum	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
class	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
order	0.13%	0.13%	0.00%	0.00%	0.13%	0.00%	0.00%	0.00%	0.26%	0.00%	0.26%	0.00%	0.00%	0.00%	0.07%
family	0.39%	0.91%	0.39%	0.00%	1.43%	1.43%	4.30%	0.39%	19.69%	3.26%	3.00%	0.13%	0.00%	1.43%	2.63%
genus	1.56%	1.17%	0.52%	0.65%	1.83%	4.95%	4.43%	3.26%	20.21%	66.49%	3.39%	23.47%	0.39%	1.96%	9.59%



	P1A	P1O	P2A	P2O	P3A	P3O	P4A	P4O	P5A	P5O	P6A	P6O	P7A	P8O	average
phylum	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
class	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
order	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
family	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
genus	1.22%	0.00%	0.00%	0.00%	0.00%	2.04%	0.00%	0.00%	0.00%	0.00%	0.41%	0.00%	0.00%	1.63%	0.38%











D_0_Bacteria_D_1_Proteobacteria_D_2_Betaproteobacteria_D_3_Burkholderiales_D_4_Burkholderiaceae_D_5_Lutomyces	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.02%	0.00%	0.00%	0.00%	0.00%
D_0_Bacteria_D_1_Proteobacteria_D_2_Betaproteobacteria_D_3_Burkholderiales_D_4_Burkholderia_incertae_sedis_D_5_Thiomonas	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.02%
D_0_Bacteria_D_1_Proteobacteria_D_2_Betaproteobacteria_D_3_Hydrogenisphaerales_D_4_Hydrogenisphaerales_D_5_Hydrogenisphaera	0.00%	0.02%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
D_0_Bacteria_D_1_Proteobacteria_D_2_Betaproteobacteria_D_3_Nitrospirales_D_4_Nitrospirales_D_5_Nitrospira	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
D_0_Bacteria_D_1_Proteobacteria_D_2_Betaproteobacteria_D_3_Nitrospirales_D_4_Nitrospirales_D_5_uncultured_bacterium	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.02%
D_0_Bacteria_D_1_Proteobacteria_D_2_Betaproteobacteria_D_3_Rhodocyclales_D_4_Rhodocyclales_D_5_Georgiella	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.02%
D_0_Bacteria_D_1_Proteobacteria_D_2_Betaproteobacteria_D_3_Rhodocyclales_D_4_Rhodocyclales_D_5_uncultured_soil_bacterium	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.02%
D_0_Bacteria_D_1_Proteobacteria_D_2_Deltaproteobacteria_D_3_Desulfobacteriales_D_4_Desulfobacteriales_D_5_Desulfotomaculum	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
D_0_Bacteria_D_1_Proteobacteria_D_2_Deltaproteobacteria_D_3_Desulfobacteriales_D_4_Desulfobacteriales_D_5_Desulfocapsa	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
D_0_Bacteria_D_1_Proteobacteria_D_2_Deltaproteobacteria_D_3_Mycosphaeriales_D_4_Her-168-1158-D_5_uncultured_bacterium	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.02%	0.00%	0.00%	0.00%	0.00%
D_0_Bacteria_D_1_Proteobacteria_D_2_Deltaproteobacteria_D_3_Mycosphaeriales_D_4_Mycosphaeriales_D_5_Caulobacterium_equisetum	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.02%
D_0_Bacteria_D_1_Proteobacteria_D_2_Deltaproteobacteria_D_3_Mycosphaeriales_D_4_Polyunguicaceae_D_5_Bysoviox	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.02%	0.00%	0.00%	0.00%
D_0_Bacteria_D_1_Proteobacteria_D_2_Deltaproteobacteria_D_3_Mycosphaeriales_D_4_uncultured_Cytophaga_bacterium	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.02%
D_0_Bacteria_D_1_Proteobacteria_D_2_Deltaproteobacteria_D_3_Syntrophobacterales_D_4_Syntrophobacterales_D_5_Desulfotomaculum	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.02%
D_0_Bacteria_D_1_Proteobacteria_D_2_Epsilonproteobacteria_D_3_Epsilonproteobacteria_D_4_uncultured_Mariprofundum_sp.	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
D_0_Bacteria_D_1_Proteobacteria_D_2_Gammaproteobacteria_D_3_EC-D_4_uncultured_bacterium_D_5_uncultured_bacterium	0.00%	0.00%	0.00%	0.02%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
D_0_Bacteria_D_1_Proteobacteria_D_2_Gammaproteobacteria_D_3_Methylospirales_D_4_Methylospirales_D_5_Methylospirillum	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.02%
D_0_Bacteria_D_1_Proteobacteria_D_2_Gammaproteobacteria_D_3_PRR10-D_4_uncultured_gamma_proteobacterium_D_5_uncultured_gamma_proteobacterium	0.00%	0.00%	0.02%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
D_0_Bacteria_D_1_Proteobacteria_D_2_Gammaproteobacteria_D_3_PRR10-D_4_uncultured_gamma_proteobacterium_D_5_uncultured_gamma_proteobacterium	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.02%
D_0_Bacteria_D_1_Proteobacteria_D_2_Gammaproteobacteria_D_3_Pseudomonadales_D_4_Pseudomonadales_D_5_uncultured	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.02%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
D_0_Bacteria_D_1_Proteobacteria_D_2_Gammaproteobacteria_D_3_Thiotrichales_D_4_Psittaculaceae_D_5_Cycolactis	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.02%	0.00%	0.00%	0.00%	0.00%
D_0_Bacteria_D_1_Proteobacteria_D_2_Gammaproteobacteria_D_3_Thiotrichales_D_4_Psittaculaceae_D_5_Methylophilus	0.00%	0.02%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
D_0_Bacteria_D_1_Proteobacteria_D_2_Gammaproteobacteria_D_3_Xanthomonadales_D_4_Xanthomonadales_D_5_uncultured	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.02%
D_0_Bacteria_D_1_Proteobacteria_D_2_Gammaproteobacteria_D_3_Xanthomonadales_D_4_Xanthomonadales_D_5_Dyella	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.02%
D_0_Bacteria_D_1_Proteobacteria_D_2_Gammaproteobacteria_D_3_Xanthomonadales_D_4_Xanthomonadales_D_5_Metabacterium	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
D_0_Bacteria_D_1_Proteobacteria_D_2_Gammaproteobacteria_D_3_Xanthomonadales_D_4_Xanthomonadales_D_5_Xanthomonadales_bacterium_K-1-9	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.02%
D_0_Bacteria_D_1_Verrucomicrobiales_D_2_Spirillum_D_3_Citrobacteriales_D_4_DNAII soil group_D_5_uncultured_soil_bacterium	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.02%	0.00%

b

Taxon	average	P1A	P1O	P2A	P2O	P3A	P3O	P4A	P4O	P5A	P5O	P6A	P6O	P7A	P8O
D_0_Archaea_D_1_Euryarchaeota_D_2_Methanosarcina_D_3_Methanosarcina_D_4_Methanosarcina_D_5_Methanosarcina	42.30%	0.377%	1.39%	74.45%	94.00%	94.26%	1.47%	78.88%	12.13%	46.94%	14.21%	7.61%	46.62%	37.09%	0.00%
D_0_Archaea_D_1_Euryarchaeota_D_2_Methanohalobium_D_3_Methanohalobium_D_4_Methanohalobium_D_5_Methanohalobium	7.69%	0.67%	0.13%	2.22%	0.00%	0.00%	0.00%	0.00%	0.00%	0.79%	0.11%	0.11%	26.40%	6.39%	0.91%
D_0_Archaea_D_1_Euryarchaeota_D_2_Methanosarcina_D_3_Methanosarcina_D_4_Methanosarcina_D_5_Methanosarcina	0.07%	0.55%	79.79%	0.00%	0.00%	0.00%	0.39%	0.00%	0.13%	0.00%	0.52%	4.64%	1.56%	0.00%	0.00%
D_0_Archaea_D_1_Euryarchaeota_D_2_Methanosarcina_D_3_Methanosarcina_D_4_Methanosarcina_D_5_Methanosarcina	0.05%	0.24%	0.00%	0.39%	0.00%	0.78%	48.66%	9.31%	12.20%	1.30%	0.13%	0.00%	0.13%	0.00%	0.00%
D_0_Archaea_D_1_Euryarchaeota_D_2_Methanosarcina_D_3_Methanosarcina_D_4_Methanosarcina_D_5_Methanosarcina	5.10%	0.00%	0.00%	0.91%	0.91%	0.39%	19.43%	1.69%	44.20%	0.00%	0.00%	0.00%	0.00%	3.91%	0.00%
D_0_Archaea_D_1_Euryarchaeota_D_2_Thermococcus_D_3_Thermococcus_D_4_Thermococcus_D_5_Thermococcus	4.59%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.26%	0.26%	0.00%	0.00%	0.00%	61.75%
D_0_Archaea_D_1_Euryarchaeota_D_2_Methanohalobium_D_3_Methanohalobium_D_4_Methanohalobium_D_5_Methanohalobium	3.59%	0.39%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	19.82%	1.36%	0.13%	0.39%	0.00%	28.16%
D_0_Archaea_D_1_Euryarchaeota_D_2_Archaeoglobus_D_3_Archaeoglobus_D_4_Archaeoglobus_D_5_undefined	3.50%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	12.99%	0.00%	16.04%	0.00%	0.00%
D_0_Archaea_D_1_Euryarchaeota_D_2_Methanosarcina_D_3_Methanosarcina_D_4_Methanosarcina_D_5_Methanosarcina	1.02%	22.41%	17.47%	0.13%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.13%	0.00%	0.13%	0.00%	1.96%
D_0_Archaea_D_1_Euryarchaeota_D_2_Archaeoglobus_D_3_Archaeoglobus_D_4_Archaeoglobus_D_5_undefined	2.31%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.39%	26.08%	0.00%	6.13%	0.00%	0.00%
D_0_Archaea_D_1_Euryarchaeota_D_2_Thermoplasma_D_3_Kanazaki-DP-4_undefined euryarchaeote	2.10%	0.26%	0.39%	0.13%	0.00%	1.36%	1.17%	2.87%	0.26%	19.43%	1.26%	0.26%	0.00%	0.00%	0.13%
D_0_Archaea_D_1_Euryarchaeota_D_2_Methanosarcina_D_3_Methanosarcina_D_4_Methanosarcina_D_5_Methanosarcina	1.70%	0.26%	0.00%	4.82%	2.26%	1.83%	3.91%	0.13%	2.74%	0.00%	0.11%	0.00%	0.00%	6.78%	0.00%
D_0_Archaea_D_1_Euryarchaeota_D_2_Haloferax_D_3_Haloferax_D_4_Miscellaneous Euryarchaeote Group/MEG/D_5_Candidatus Iainarchaeum	1.11%	0.13%	0.00%	15.22%	0.13%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
D_0_Archaea_D_1_Euryarchaeota_D_2_Methanosarcina_D_3_Methanosarcina_D_4_Methanosarcina_D_5_Methanosarcina	1.08%	0.00%	0.00%	1.04%	0.91%	0.82%	0.00%	3.91%	4.17%	1.17%	0.00%	1.17%	0.13%	1.17%	0.39%
D_0_Archaea_D_1_Euryarchaeota_D_2_Archaeoglobus_D_3_Archaeoglobus_D_4_Archaeoglobus_D_5_undefined	0.46%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	5.22%	0.00%	1.17%	0.00%	0.00%
D_0_Archaea_D_1_Euryarchaeota_D_2_Haloferax_D_3_Haloferax_D_4_Deep Sea Hydrothermal Vent (pH 9.5) D_5_undefined euryarchaeote	0.39%	0.00%	0.26%	0.00%	0.00%	0.00%	0.13%	0.00%	0.00%	0.00%	3.78%	0.00%	0.00%	0.00%	0.00%
D_0_Archaea_D_1_Euryarchaeota_D_2_Thermoplasma_D_3_Thermoplasma_D_4_Territorial Miscellaneous (pH 7.0) D_5_undefined archaeon	0.28%	0.00%	0.00%	0.39%	0.00%	1.60%	0.00%	1.83%	0.00%	1.83%	0.00%	0.00%	0.00%	0.00%	0.00%
D_0_Archaea_D_1_Euryarchaeota_D_2_Thermoplasma_D_3_WCHA-157/D_4_undefined archaeon	0.23%	0.00%	0.00%	0.26%	0.00%	0.00%	0.13%	0.39%	0.00%	0.00%	0.00%	2.35%	0.13%	0.00%	0.00%
D_0_Archaea_D_1_Euryarchaeota_D_2_Methanosarcina_D_3_Methanosarcina_D_4_Methanosarcina_D_5_Methanosarcina	0.18%	0.00%	0.00%	0.00%	0.13%	0.00%	1.54%	0.00%	0.25%	0.00%	0.26%	0.00%	0.00%	0.00%	0.00%
D_0_Archaea_D_1_Euryarchaeota_D_2_Haloferax_D_3_Haloferax_D_4_Haloferax_D_5_Candidatus Haloferax	0.16%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	2.22%
D_0_Archaea_D_1_Euryarchaeota_D_2_Haloferax_D_3_Haloferax_D_4_Deep Sea Hydrothermal Vent (pH 9.5) D_5_undefined archaeon	0.11%	0.00%	0.00%	0.13%	0.26%	0.26%	0.91%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
D_0_Archaea_D_1_Euryarchaeota_D_2_Methanosarcina_D_3_Methanosarcina_D_4_Methanosarcina_D_5_Methanosarcina	0.10%	0.00%	0.00%	0.00%	0.00%	0.00%	0.78%	0.00%	0.65%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
D_0_Archaea_D_1_Thermoplasma_D_2_Thermoplasma_D_3_Territorial Miscellaneous (pH 7.0) D_4_undefined Thermoplasma archaeon	0.09%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	1.30%
D_0_Archaea_D_1_Euryarchaeota_D_2_Methanosarcina_D_3_Methanosarcina_D_4_Methanosarcina_D_5_undefined	0.08%	1.61%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.13%	0.00%	0.00%	0.00%
D_0_Archaea_D_1_Euryarchaeota_D_2_Methanohalobium_D_3_Methanohalobium_D_4_Methanohalobium_D_5_Methanohalobium	0.07%	0.00%	0.00%	0.26%	0.00%	0.00%	0.78%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
D_0_Archaea_D_1_Euryarchaeota_D_2_Thermoplasma_D_3_Thermoplasma_D_4_Marine Group I/D_5_undefined euryarchaeote	0.07%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
D_0_Archaea_D_1_Euryarchaeota_D_2_Thermoplasma_D_3_Thermoplasma_D_4_288-4/D_5_undefined archaeon	0.06%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.26%	0.00%	0.00%	0.00%	0.00%
D_0_Archaea_D_1_Euryarchaeota_D_2_Haloferax_D_3_Haloferax_D_4_Haloferax_D_5_Haloferax	0.05%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.65%
D_0_Archaea_D_1_Euryarchaeota_D_2_Thermoplasma_D_3_Kanazaki-DP-4_undefined archaeon	0.05%	0.00%	0.39%	0.00%	0.00%	0.00%	0.13%	0.13%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
D_0_Archaea_D_1_Euryarchaeota_D_2_Methanohalobium_D_3_Methanohalobium_D_4_Methanohalobium_D_5_undefined	0.04%	0.00%	0.00%	0.00%	0.00%	0.13%	0.00%	0.00%	0.00%	0.13%	0.00%	0.26%	0.00%	0.00%	0.00%
D_0_Archaea_D_1_Euryarchaeota_D_2_Methanosarcina_D_3_Methanosarcina_D_4_Methanosarcina_D_5_undefined	0.04%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.22%
D_0_Archaea_D_1_Euryarchaeota_D_2_Methanosarcina_D_3_Methanosarcina_D_4_LR-13/D_5_undefined archaeon	0.03%	0.00%	0.00%	0.00%	0.00%	0.00%	0.26%	0.00%	0.13%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
D_0_Archaea_D_1_Euryarchaeota_D_2_Thermoplasma_D_3_Thermoplasma_D_4_014908-A8-DP13/D_5_undefined archaeon	0.03%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.26%	0.13%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
D_0_Archaea_D_1_Euryarchaeota_D_2_Thermoplasma_D_3_Thermoplasma_D_4_Marine Group II/D_5_undefined archaeon	0.03%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.26%	0.00%	0.00%	0.00%	0.13%	0.00%	0.00%	0.00%
D_0_Archaea_D_1_Euryarchaeota_D_2_Thermoplasma_D_3_Thermoplasma_D_4_Thermoplasma Incense Sedge/D_5_Candidatus Methanohalobium	0.03%	0.00%	0.00%	0.00%	0.13%	0.00%	0.13%	0.00%	0.13%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
D_0_Archaea_D_1_Euryarchaeota_D_2_Archaeoglobus_D_3_Archaeoglobus_D_4_Archaeoglobus_D_5_undefined	0.03%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
D_0_Archaea_D_1_Euryarchaeota_D_2_Methanosarcina_D_3_Methanosarcina_D_4_Methanosarcina_D_5_Methanosarcina	0.03%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.39%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
D_0_Archaea_D_1_Euryarchaeota_D_2_Methanosarcina_D_3_Methanosarcina_D_4_Methanosarcina_D_5_undefined	0.03%	0.00%	0.00%	0.00%	0.00%	0.00%	0.39%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
D_0_Archaea_D_1_Euryarchaeota_D_2_Thermoplasma_D_3_Thermoplasma_D_4_Thermoplasma_D_5_Thermoplasma	0.02%	0.00%	0.39%	0.00%	0.00%	0.00%	0.13%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
D_0_Archaea_D_1_Euryarchaeota_D_2_Haloferax_D_3_Haloferax_D_4_Miscellaneous Euryarchaeote Group/MEG/D_5_undefined archaeon	0.02%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.26%	0.00%
D_0_Archaea_D_1_Euryarchaeota_D_2_Methanosarcina_D_3_Methanosarcina_D_4_Methanosarcina_D_5_undefined	0.02%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.22%
D_0_Archaea_D_1_Euryarchaeota_D_2_Methanosarcina_D_3_Methanosarcina_D_4_Methanosarcina_D_5_Methanosarcina	0.02%	0.00%	0.00%	0.00%	0.00%	0.26%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
D_0_Archaea_D_1_Thermoplasma_D_2_Thermoplasma_D_3_Marine Group I/D_4_undefined archaeon	0.02%	0.11%	0.00%	0.00%	0.00%	0.13%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
D_0_Archaea_D_1_Thermoplasma_D_2_Marine Group II/D_3_Ulkenow Order/D_4_Ulkenow Family/D_5_Candidatus Nitrososphaera	0.02%	0.00%	0.13%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.13%	0.00%	0.00%	0.00%	0.00%	0.00%
D_0_Archaea_D_1_Thermoplasma_D_2_Territorial Hot Spring (pH 7.0) D_3_Ulkenow Order/D_4_Ulkenow Family/D_5_Candidatus Caldiarchaeum	0.02%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.26%	0.00%	0.00%	0.00%
D_0_Archaea_D_1_Euryarchaeota_D_2_Archaeoglobus_D_3_Archaeoglobus_D_4_Archaeoglobus_D_5_Geoglobus	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.13%	0.00%	0.00%	0.00%	0.00%
D_0_Archaea_D_1_Euryarchaeota_D_2_Haloferax_D_3_Haloferax_D_4_Deep Sea Hydrothermal Vent (pH 9.5) D_5_undefined euryarchaeote	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.13%	0.00%	0.00%	0.00%	0.00%
D_0_Archaea_D_1_Euryarchaeota_D_2_Haloferax_D_3_Haloferax_D_4_Deep Sea Hydrothermal Vent (pH 9.5) D_5_undefined archaeon	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
D_0_Archaea_D_1_Euryarchaeota_D_2_Haloferax_D_3_Haloferax_D_4_Haloferax_D_5_Haloferax	0.01%	0.00%	0.13%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
D_0_Archaea_D_1_Euryarchaeota_D_2_Haloferax_D_3_Haloferax_D_4_Miscellaneous Euryarchaeote Group/MEG/D_5_undefined	0.01%	0.00%	0.00%	0.00%	0.00%	0.13%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
D_0_Archaea_D_1_Euryarchaeota_D_2_Thermoplasma_D_3_Thermoplasma_D_4_Territorial Miscellaneous (pH 7.0) D_5_undefined Thermoplasma archaeon	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.13%	0.00%
D_0_Archaea_D_1_Euryarchaeota_D_2_Thermoplasma_D_3_Thermoplasma_D_4_WC12 Ac6/D_5_undefined archaeon WC12 Ac6	0.01%	0.13%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
D_0_Archaea_D_1_Thermoplasma_D_2_Marine Group I/D_3_undefined archaeon/D_4_undefined archaeon/D_5_undefined archaeon	0.01%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.13%	0.00%	0.00%	0.00%	0.00%	0.00%

**Table S4.** Shared OTU numbers of all pairs of samples (I). The statistical table of average shared OTU numbers and the percentages of shared OTU numbers in each sample's OTU numbers (II). a) bacterial community tables; b) archaeal community tables.

a	I	P1A	P1O	P2A	P2O	P3A	P3O	P4A	P4O	P5A	P5O	P6A	P6O	P7A	P8O
	P1A	743	205	228	228	241	248	230	208	265	206	243	249	295	232
	P1O	205	553	195	184	183	207	201	168	235	179	188	218	234	202
	P2A	228	195	721	249	235	250	244	202	239	210	247	264	302	225
	P2O	228	184	249	670	226	237	234	203	254	214	239	237	278	216
	P3A	241	183	235	226	922	323	296	228	272	217	238	266	306	230
	P3O	248	207	250	237	323	973	286	338	307	238	269	282	325	240
	P4A	230	201	244	234	296	286	795	260	260	204	253	258	300	236
	P4O	208	168	202	203	228	338	260	844	227	176	220	231	259	194
	P5A	265	235	239	254	272	307	260	227	892	280	273	297	322	269
	P5O	206	179	210	214	217	238	204	176	280	670	213	245	249	220
	P6A	243	188	247	239	238	269	253	220	273	213	770	302	329	257
	P6O	249	218	264	237	266	282	258	231	297	245	302	827	330	259
	P7A	295	234	302	278	306	325	300	259	322	249	329	330	1033	272
	P8O	232	202	225	216	230	240	236	194	269	220	257	259	272	727
	II	P1A	P1O	P2A	P2O	P3A	P3O	P4A	P4O	P5A	P5O	P6A	P6O	P7A	P8O
	average shared OTU number	236.8	199.9	237.7	230.7	250.8	273.1	250.9	224.2	269.2	219.3	251.6	264.5	292.4	234.8
	OTU number	743	553	721	670	922	973	795	844	892	670	770	827	1033	727
	percentage	31.9%	36.2%	33.0%	34.4%	27.2%	28.1%	31.6%	26.6%	30.2%	32.7%	32.7%	32.0%	28.3%	32.3%
b	I	P1A	P1O	P2A	P2O	P3A	P3O	P4A	P4O	P5A	P5O	P6A	P6O	P7A	P8O
	P1A	66	14	17	7	16	7	9	8	18	7	14	7	8	4
	P1O	14	26	4	1	1	2	1	3	3	6	4	5	2	2
	P2A	17	4	51	21	25	8	15	12	18	5	12	4	12	2
	P2O	7	1	21	52	12	3	9	6	8	2	5	2	10	0
	P3A	16	1	25	12	76	10	25	9	21	1	10	1	6	0
	P3O	7	2	8	3	10	57	11	20	7	2	4	1	2	0
	P4A	9	1	15	9	25	11	68	18	17	2	10	1	6	0
	P4O	8	3	12	6	9	20	18	72	10	4	5	1	6	0
	P5A	18	3	18	8	21	7	17	10	55	9	15	5	10	4
	P5O	7	6	5	2	1	2	2	4	9	63	5	19	3	5
	P6A	14	4	12	5	10	4	10	5	15	5	37	6	7	2
	P6O	7	5	4	2	1	1	1	1	5	19	6	52	8	3
	P7A	8	2	12	10	6	2	6	6	10	3	7	8	44	1
	P8O	4	2	2	0	0	0	0	0	4	5	2	3	1	16
	II	P1A	P1O	P2A	P2O	P3A	P3O	P4A	P4O	P5A	P5O	P6A	P6O	P7A	P8O
	average shared OTU number	10.5	3.7	11.9	6.6	10.5	5.9	9.5	7.8	11.2	5.4	7.6	4.8	6.2	1.8
	OTU number	66	26	51	52	76	57	68	72	55	63	37	52	44	16
	percentage	15.9%	14.2%	23.4%	12.7%	13.9%	10.4%	14.0%	10.9%	20.3%	8.5%	20.6%	9.3%	14.2%	11.1%

**Table S5.** Functional roles and corresponding reference of core bacterial microbiome in all petroleum samples. Core microbial OTUs (23 OTUs) were affiliated to the most abundant genera.

Genus name	Average Abundance	Function role				References
Pseudomonas (Gamma.)	14.3%	Hydrocarbon degrader	Nitrate/Nitrite reducer		(Ma et al., 2006; Wentzel et al., 2007; Mehboob et al., 2009; Zhang et al., 2011)	
Acinetobacter (Gamma.)	7.4%	Aerobic hydrocarbon degrader			(Lal and Khanna, 1996; DiCello et al., 1997; Zhang et al., 2014)	
Hydrogenophilaceae UG (Beta.)	5.0%	Fermentative bacteria	Nitrate/Nitrite reducer		(Hayashi et al., 1999; Salinas et al., 2004)	
Marinobacter (Gamma.)	2.8%	Hydrocarbon degrader	Nitrate/Nitrite reducer		(Gauthier et al., 1992; Takai et al., 2005)	
Nitricola (Gamma.)	2.6%	Aerobic hydrocarbon degrader	Nitrate/Nitrite reducer		(Dimitriu et al., 2005; Tiquia, 2010)	
Thermaceae UG (D.-T.)	2.4%	Fermentative bacteria	Nitrate/Nitrite reducer		(Miroshnichenko et al., 2003a; Miroshnichenko et al., 2003b)	
Proteiniphilum (Bac.)	2.4%	Hydrocarbon degrader			(Chen and Dong, 2005; Gargouri et al., 2014)	
Deferribacteraceae UG (Deferri.)	2.2%	Hydrocarbon degrader	Nitrate/Nitrite reducer	Sulfidogenic bacteria (SRB)	(Greene et al., 1997; Takai et al., 2003)	
Thaueria (Beta.)	2.1%	Hydrocarbon degrader	Nitrate/Nitrite reducer		(Foss and Harder, 1998; Song et al., 2001; Mechichi et al., 2002; Dubbels et al., 2009; Sun and Cupples, 2012)	
Bacteriovoracaceae UG (Delta.)	2.1%					
Psychrobacter (Gamma.)	1.9%	Aerobic hydrocarbon degrader			(Deppe et al., 2005; Bowman and Denning, 2014)	
Sulfurovum (Epsilon.)	1.7%	Sulfur cycling bacteria			(Inagaki et al., 2004; Mino et al., 2014)	
Defluviimonas (Alpha.)	1.3%	Nitrate/Nitrite reducer			(Foesel et al., 2011; Pan et al., 2015)	
Balneola (Bac.)	1.2%	Aerobic hydrocarbon degrader			(Urios et al., 2006; Urios et al., 2008; Li et al., 2012)	
Mesotoga (Thermo.)	0.9%	Hydrocarbon degrader	Fermentative bacteria	Sulfidogenic bacteria (SRB)	Acetogen (Nesbo et al., 2012; Ben Hania et al., 2013) (Rosenberg et al., 2014)	
VC2.1 Bac22 UG (Bac.)	0.8%					
Simplicispira (Beta.)	0.8%					
Stappia (Alpha.)	0.7%	Aerobic hydrocarbon degrader			(Al-Awadhi et al., 2007; Lai et al., 2010)	
Glycocaulis (Alpha.)	0.7%	Aerobic hydrocarbon degrader			(Lv et al., 2014; Geng et al., 2015)	
ML635J-40 aquatic group UG (Bac.)	0.6%	Fermentative bacteria			(Nolla-Ardevol et al., 2015)	
Spirochaetaceae UG (Spiro.)	0.6%	Fermentative bacteria	Acetogen		(Graber and Breznak, 2004; Cheng et al., 2013)	
Novosphingobium (Alpha.)	0.6%	Hydrocarbon degrader	Nitrate/Nitrite reducer		(Sohn et al., 2004; Liu et al., 2005; Addison et al., 2007; Niharika et al., 2013)	
Clostridiales Family XI UG (Fir.)	0.5%	Fermentative bacteria	Sulfidogenic bacteria (SRB)	Syntrophic acetate oxidizer	Acetogen (Jones and Vandecasteele, 2008; Müller et al., 2013)	
Others	44.4%					

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**Table S6.** The taxonomic summary of shared OTUs of bacterial communities between a) aqueous samples, b) oil samples, c) all samples. Red labeled genera acquired average proportional size over 0.5%.

Taxon	average	PIA	PIO	P2A	P2O	P3A	P3O	P4A	P4O	P5A	P5O	P6A	P6O	P7A	P8O
D_0_Bacteria_D_1_Proteobacteria_D_2_Gammaproteobacteria_D_3_Pseudomonadales_D_4_Pseudomonadaceae_D_5_Pseudomonas	14.3%	22.6%	1.0%	37.1%	17.9%	4.1%	3.7%	2.1%	1.7%	6.1%	5.4%	30.4%	18.8%	21.5%	33.4%
D_0_Bacteria_D_1_Proteobacteria_D_2_Gammaproteobacteria_D_3_Pseudomonadales_D_4_Moraxellaceae_D_5_Acinetobacter	8.3%	1.5%	1.6%	26.9%	35.2%	1.4%	1.5%	38.9%	0.6%	1.3%	1.3%	1.1%	1.4%	2.5%	1.5%
D_0_Bacteria_D_1_Proteobacteria_D_2_Betaproteobacteria_D_3_Hydrogenisphaerales_D_4_Hydrogenisphaeraceae_D_5_unclassified	5.0%	0.7%	0.7%	0.5%	0.6%	0.4%	20.1%	0.6%	42.0%	0.8%	0.6%	0.7%	0.6%	1.1%	0.5%
D_0_Bacteria_D_1_Proteobacteria_D_2_Gammaproteobacteria_D_3_Alteromonadales_D_4_Alteromonadaceae_D_5_Marinobacter	2.8%	0.3%	0.4%	0.4%	0.5%	0.3%	1.4%	0.3%	0.2%	9.9%	21.6%	0.2%	0.4%	0.3%	3.3%
D_0_Bacteria_D_1_Bacteroidetes_D_2_Bacteroidia_D_3_Bacteroidales_D_4_Porphyromonadaceae_D_5_Porphyromonadaceae	2.6%	4.2%	2.7%	5.8%	8.3%	0.5%	0.9%	0.5%	0.3%	5.2%	0.8%	2.0%	1.7%	3.3%	0.2%
D_0_Bacteria_D_1_Proteobacteria_D_2_Gammaproteobacteria_D_3_Oceanospirillales_D_4_Oceanospirillaceae_D_5_Nitrososphaera	2.6%	0.3%	0.6%	0.8%	2.9%	0.2%	0.4%	0.3%	0.2%	11.8%	17.2%	0.3%	0.4%	0.6%	0.3%
D_0_Bacteria_D_1_Deltaproteobacteria_D_2_Deltaproteobacteria_D_3_Thermococcales_D_4_Thermococcaceae_D_5_unclassified	2.4%	0.2%	27.7%	0.5%	0.6%	0.3%	0.6%	0.5%	0.3%	0.8%	1.1%	0.2%	0.5%	0.3%	0.3%
D_0_Bacteria_D_1_Deltaproteobacteria_D_2_Deltaproteobacteria_D_3_Thermococcales_D_4_Thermococcaceae_D_5_unclassified	2.2%	0.5%	0.4%	0.3%	0.3%	0.2%	0.6%	0.2%	0.6%	0.2%	0.6%	0.9%	0.9%	0.3%	0.1%
D_0_Bacteria_D_1_Proteobacteria_D_2_Betaproteobacteria_D_3_Rhodocyclales_D_4_Rhodocyclaceae_D_5_Thaera	2.1%	0.5%	0.2%	0.4%	0.4%	0.2%	0.5%	0.5%	0.6%	0.4%	0.4%	3.3%	13.4%	8.7%	0.3%
D_0_Bacteria_D_1_Proteobacteria_D_2_Deltaproteobacteria_D_3_Bdellovibrionales_D_4_Bacteriovoraceae_D_5_unclassified	2.1%	0.1%	0.2%	0.2%	0.2%	0.1%	0.2%	0.1%	0.2%	15.0%	0.4%	0.3%	0.2%	0.3%	0.2%
D_0_Bacteria_D_1_Proteobacteria_D_2_Gammaproteobacteria_D_3_Pseudomonadales_D_4_Moraxellaceae_D_5_Psychrobacter	1.9%	23.9%	0.1%	0.2%	0.2%	0.1%	0.2%	0.2%	0.1%	0.2%	0.2%	0.3%	0.3%	0.2%	0.1%
D_0_Bacteria_D_1_Proteobacteria_D_2_Epsilonproteobacteria_D_3_Campylobacteriales_D_4_Helicobacteraceae_D_5_Sulfaromonas	1.7%	0.2%	0.1%	0.2%	0.1%	21.2%	0.4%	0.2%	0.4%	0.2%	0.2%	0.1%	0.1%	0.2%	0.2%
D_0_Bacteria_D_1_Proteobacteria_D_2_Deltaproteobacteria_D_3_Bdellovibrionales_D_4_Bdellovibrionaceae_D_5_Sesolobus	1.4%	0.2%	0.0%	0.0%	0.0%	4.5%	4.4%	0.2%	8.1%	0.2%	0.1%	0.2%	0.2%	0.1%	0.1%
D_0_Bacteria_D_1_Proteobacteria_D_2_Alphaproteobacteria_D_3_Caulobacteriales_D_4_Rhodobacteraceae_D_5_Delfinium	1.3%	0.3%	14.2%	0.3%	0.2%	0.1%	0.2%	0.2%	0.1%	1.7%	0.6%	0.1%	0.2%	0.1%	0.2%
D_0_Bacteria_D_1_Bacteroidetes_D_2_Cytophagae_D_3_Order_IHJ_D_4_Unknown_Family_D_5_Balboa	1.2%	0.1%	15.4%	0.1%	0.1%	0.1%	0.1%	0.2%	0.0%	0.2%	0.5%	0.0%	0.1%	0.1%	0.1%
D_0_Bacteria_D_1_Thermotoga_D_2_Thermotogales_D_3_Thermotogales_D_4_Thermotogaceae_D_5_Meotoga	0.9%	2.2%	0.2%	0.0%	0.1%	5.9%	3.0%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.2%	0.0%
D_0_Bacteria_D_1_Proteobacteria_D_2_Alphaproteobacteria_D_3_Rhodobacteriales_D_4_Rhodobacteraceae_D_5_Sappia	0.8%	0.1%	0.2%	0.5%	1.1%	0.1%	0.1%	0.1%	0.0%	5.4%	3.8%	0.1%	0.1%	0.1%	0.0%
D_0_Bacteria_D_1_Bacteroidetes_D_2_VC2.1_Bac2.D.3_unclassified_bacterium_D_4_unclassified_bacterium_D_5_unclassified_bacterium	0.8%	0.0%	0.0%	0.0%	0.0%	4.5%	0.0%	0.1%	0.0%	0.1%	0.2%	1.1%	4.2%	0.1%	0.0%
D_0_Bacteria_D_1_Proteobacteria_D_2_Betaproteobacteria_D_3_Burkholderiales_D_4_Cornimonadaceae_D_5_Simplicispira	0.8%	0.2%	0.1%	3.1%	1.6%	0.2%	0.2%	0.1%	0.1%	0.5%	0.3%	2.3%	1.0%	1.2%	0.1%
D_0_Bacteria_D_1_Proteobacteria_D_2_Alphaproteobacteria_D_3_Rhodospirillales_D_4_Rhodospirillaceae_D_5_Terrimonas	0.8%	0.1%	0.2%	0.5%	1.1%	0.1%	0.1%	0.1%	0.0%	5.4%	3.8%	0.1%	0.1%	0.1%	0.0%
D_0_Bacteria_D_1_Candidate_division_ISI_D_2_Ambisartia_bacterium_SCGC_AB164-M20D_3_Ambisartia_bacterium_SCGC_AB164-M20D_4_Ambisartia_bacterium_SCGC_AB164-M20D_5_Ambisartia_bacterium_SCGC_AB164-M20D	0.7%	0.0%	0.0%	0.0%	0.0%	9.2%	0.2%	0.1%	0.0%	0.1%	0.1%	0.0%	0.1%	0.1%	0.1%
D_0_Bacteria_D_1_Proteobacteria_D_2_Alphaproteobacteria_D_3_Caulobacteriales_D_4_Hyphomonadaceae_D_5_Glycoactis	0.7%	0.1%	0.1%	0.0%	0.0%	0.1%	0.1%	0.1%	0.1%	0.2%	0.6%	0.1%	0.0%	0.1%	7.8%
D_0_Bacteria_D_1_Bacteroidetes_D_2_Bacteroidia_D_3_Bacteroidales_D_4_MiL6351-40_aquatic_group_D_5_unclassified_bacterium	0.6%	0.0%	0.0%	0.0%	0.3%	0.1%	0.1%	0.1%	0.0%	2.4%	2.7%	0.2%	2.0%	0.0%	0.1%
D_0_Bacteria_D_1_Proteobacteria_D_2_Epsilonproteobacteria_D_3_Campylobacteriales_D_4_Helicobacteraceae_D_5_Wolacella	0.6%	0.1%	0.0%	0.1%	0.0%	0.1%	0.0%	0.0%	0.1%	0.0%	0.1%	0.0%	0.3%	1.0%	0.8%
D_0_Bacteria_D_1_Spirochaetes_D_2_Spirochaetia_D_3_Spirochaetiales_D_4_Spirochaetaceae_D_5_unclassified	0.6%	0.0%	0.1%	0.1%	0.0%	0.1%	0.1%	5.0%	1.1%	0.1%	0.0%	0.5%	0.3%	0.6%	0.1%
D_0_Bacteria_D_1_Firmicutes_D_2_Bacilli_D_3_Bacillales_D_4_Family_X1D_5_Esqvaterium	0.6%	0.2%	0.0%	0.1%	0.0%	0.0%	0.0%	0.2%	0.0%	0.0%	0.0%	3.9%	0.0%	0.3%	0.0%
D_0_Bacteria_D_1_Proteobacteria_D_2_Alphaproteobacteria_D_3_Sphingomonadales_D_4_Sphingomonadaceae_D_5_Novosphingium	0.6%	0.0%	0.1%	0.1%	0.1%	0.1%	0.1%	4.5%	1.1%	0.1%	0.0%	1.0%	1.4%	1.0%	0.0%
D_0_Bacteria_D_1_Firmicutes_D_2_Clostridia_D_3_Clostridiales_D_4_Family_X1D_5_unclassified	0.5%	0.8%	0.1%	0.1%	0.0%	0.0%	0.2%	0.0%	0.1%	2.0%	0.1%	3.7%	0.2%	0.2%	0.0%
D_0_Bacteria_D_1_Proteobacteria_D_2_Gammaproteobacteria_D_3_Xanthomonadales_D_4_Unknown_Family_D_5_Thiobolomus	0.4%	0.1%	0.1%	0.0%	0.1%	0.3%	4.6%	0.3%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.0%
D_0_Bacteria_D_1_Proteobacteria_D_2_Gammaproteobacteria_D_3_Xanthomonadales_D_4_Unknown_Family_D_5_Silimonas	0.4%	0.1%	4.7%	0.0%	0.1%	0.0%	0.1%	0.1%	0.1%	0.2%	0.3%	0.0%	0.2%	0.0%	0.0%
D_0_Bacteria_D_1_Proteobacteria_D_2_Alphaproteobacteria_D_3_Rhodobacteriales_D_4_Rhodobacteraceae_D_5_Pannobacter	0.4%	0.0%	0.1%	0.0%	0.1%	0.1%	0.0%	0.1%	0.0%	0.1%	2.4%	0.8%	2.0%	0.0%	0.0%
D_0_Bacteria_D_1_Actinobacteria_D_2_Actinobacteriales_D_3_Coriobacteriales_D_4_Coriorhabdaceae_D_5_unclassified	0.4%	0.1%	0.0%	0.0%	0.0%	4.8%	0.1%	0.1%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.1%
D_0_Bacteria_D_1_Proteobacteria_D_2_Hydrogenisphaerales_D_3_Hydrogenisphaeraceae_D_5_Tepidiphilus	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	1.9%	1.9%	0.0%
D_0_Bacteria_D_1_Proteobacteria_D_2_Betaproteobacteria_D_3_Rhodocyclales_D_4_Rhodocyclaceae_D_5_Azoroccus	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.2%	1.9%	1.9%	0.0%
D_0_Bacteria_D_1_Firmicutes_D_2_Clostridia_D_3_Clostridiales_D_4_Family_X1D_5_Soebingia	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.7%	0.2%	1.3%	0.2%	0.1%	0.1%
D_0_Bacteria_D_1_Proteobacteria_D_2_Betaproteobacteria_D_3_Burkholderiales_D_4_Cornimonadaceae_D_5_Acidovorax	0.2%	0.1%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	1.7%	0.6%	0.1%	0.0%
D_0_Bacteria_D_1_Actinobacteria_D_2_Actinobacteriales_D_3_Actinobacteriales_D_4_Actinobacteriaceae_D_5_Terrimonas	0.2%	0.1%	0.0%	0.0%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
D_0_Bacteria_D_1_Proteobacteria_D_2_Alphaproteobacteria_D_3_Rhizobiales_D_4_Bradyniobacteriaceae_D_5_Bradyniobacter	0.1%	0.2%	0.1%	0.1%	0.1%	0.1%	0.1%	0.1%	0.2%	0.1%	0.2%	0.2%	0.1%	0.3%	0.1%
D_0_Bacteria_D_1_Acidobacteria_D_2_Acidobacteriales_D_3_Subgroup_4D_4_RB41D_5_unclassified_bacterium	0.1%	0.2%	0.0%	0.1%	0.0%	0.1%	0.1%	0.1%	0.1%	0.0%	0.1%	0.1%	0.2%	0.2%	0.1%
D_0_Bacteria_D_1_Proteobacteria_D_2_Alphaproteobacteria_D_3_Sphingomonadales_D_4_Sphingomonadaceae_D_5_unclassified_bacterium	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.1%	0.2%	0.1%	0.4%	0.6%	0.3%
D_0_Bacteria_D_1_Acidobacteria_D_2_Acidobacteriales_D_4_Acidobacteriaceae(Subgroup_1)D_5_unclassified	0.1%	0.1%	0.1%	0.1%	0.0%	0.1%	0.1%	0.1%	0.0%	0.0%	0.0%	0.1%	0.0%	0.1%	0.1%
D_0_Bacteria_D_1_Proteobacteria_D_2_Gammaproteobacteria_D_3_Xanthomonadales_D_4_unclassified_D_5_unclassified	0.1%	0.1%	0.0%	0.1%	0.0%	0.0%	0.1%	0.1%	0.0%	0.1%	0.0%	0.0%	0.0%	0.1%	0.1%
D_0_Bacteria_D_1_Proteobacteria_D_2_Alphaproteobacteria_D_3_Rhodospirillales_D_4_Rhodospirillaceae_D_5_unclassified	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
D_0_Bacteria_D_1_Bacteroidetes_D_2_Bacteroidia_D_3_Bacteroidales_D_4_Choristobacteriaceae_D_5_unclassified	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
D_0_Bacteria_D_1_Nitrospirae_D_2_Nitrospirales_D_3_Nitrospirales_D_4_Nitrospiraceae_D_5_Nitrospira	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
D_0_Bacteria_D_1_Verrucomicrobia_D_2_Sporobacteriales_D_3_Chloroflexales_D_4_DAI101_group_D_5_unclassified_bacterium	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
D_0_Bacteria_D_1_Acidobacteria_D_2_Acidobacteriales_D_3_Subgroup_6D_4_unclassified_Acidobacterium_by_erratum_D_5_unclassified_Acidobacterium	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
sum	65.5%	61.2%	75.4%	81.0%	77.2%	56.5%	53.0%	64.8%	73.1%	64.2%	73.4%	65.0%	63.6%	49.6%	58.8%

Taxon	average	PIA	PIO	P2A	P2O	P3A	P3O	P4A	P4O	P5A	P5O	P6A	P6O	P7A	P8O
D_0_Bacteria_D_1_Proteobacteria_D_2_Gammaproteobacteria_D_3_Pseudomonadales_D_4_Pseudomonadaceae_D_5_Pseudomonas	14.3%	22.6%	1.0%	36.8%	17.8%	4.1%	3.6%	2.0%	1.7%	6.0%	5.5%	30.2%	15.7%	20.1%	33.3%
D_0_Bacteria_D_1_Proteobacteria_D_2_Gammaproteobacteria_D_3_Pseudomonadales_D_4_Moraxellaceae_D_5_Acinetobacter	8.4%	1.4%	1.1%	24.5%	31.8%	1.2%	1.2%	31.8%	1.3%	1.1%	1.2%	1.0%	1.2%	2.4%	1.4%
D_0_Bacteria_D_1_Proteobacteria_D_2_Betaproteobacteria_D_3_Hydrogenisphaerales_D_4_Hydrogenisphaeraceae_D_5_unclassified	5.0%	0.7%	0.7%	0.5%	0.6%	0.4%	20.1%	0.6%	42.0%	0.8%	0.6%	0.7%	0.6%	1.1%	0.5%
D_0_Bacteria_D_1_Proteobacteria_D_2_Gammaproteobacteria_D_3_Alteromonadales_D_4_Alteromonadaceae_D_5_Marinobacter	2.8%	0.3%	0.4%	0.4%	0.5%	0.3%	1.4%	0.3%	0.2%	9.9%	21.6%	0.2%	0.4%	0.3%	3.3%
D_0_Bacteria_D_1_Proteobacteria_D_2_Gammaproteobacteria_D_3_Oceanospirillales_D_4_Oceanospirillaceae_D_5_Nitrososphaera	2.6%	0.3%	0.6%	0.8%	2.9%	0.2%	0.4%	0.3%	0.2%	11.8%	17.2%	0.3%	0.4%	0.6%	0.3%
D_0_Bacteria_D_1_Deltaproteobacteria_D_2_Deltaproteobacteria_D_3_Thermococcales_D_4_Thermococcaceae_D_5_unclassified	2.4%	0.2%	27.7%	0.5%	0.6%	0.3%	0.6%	0.5%	0.3%	0.8%	1.1%	0.2%	0.5%	0.3%	0.3%
D_0_Bacteria_D_1_Deltaproteobacteria_D_2_Deltaproteobacteria_D_3_Thermococcales_D_4_Thermococcaceae_D_5_unclassified	2.4%	4.2%	2.7%	5.8%	8.3%	0.5%	0.8%	0.4%	0.2%	5.1%	0.8%	1.9%	1.2%	1.1%	0.2%
D_0_Bacteria_D_1_Deltaproteobacteria_D_2_Deltaproteobacteria_D_3_Thermococcales_D_4_Thermococcaceae_D_5_unclassified	2.2%	0.5%	0.4%	0.3%	0.3%	0.2%	0.6%	0.2%	0.6%	0.2%	0.6%	0.9%	0.9%	0.3%	0.1%
D_0_Bacteria_D_1_Proteobacteria_D_2_Betaproteobacteria_D_3_Rhodocyclales_D_4_Rhodocyclaceae_D_5_Thaera	2.1%	0.5%	0.2%	0.4%	0.4%	0.2%	0.5%	0.5%	0.6%	0.4%	0.4%	3.3%	13.4%	8.7%	0.3%
D_0_Bacteria_D_1_Proteobacteria_D_2_Deltaproteobacteria_D_3_Bdellovibrionales_D_4_Bacteriovoraceae_D_5_unclassified	2.1%	0.3%	0.2%	0.2%	0.2%	0.4%	11.2%	0.2%	15.0%	0.3%	0.2%	0.2%	0.3%	0.3%	0.2%
D_0_Bacteria_D_1_Proteobacteria_D_2_Gammaproteobacteria_D_3_Pseudomonadales_D_4_Moraxellaceae_D_5_Psychrobacter	1.9%	23.9%	0.1%	0.2%	0.1%	0.2%	0.2%	0.2%	0.1%	0.2%	0.2%	0.3%	0.3%	0.2%	0.1%
D_0_Bacteria_D_1_Proteobacteria_D_2_Epsilonproteobacteria_D_3_Campylobacteriales_D_4_Helicobacteraceae_D_5_Sulfaromonas	1.7%	0.2%	0.1%	0.2%	0.1%	21.2%	0.4%	0.2%	0.4%	0.2%	0.2%	0.1%	0.1%	0.2%	0.2%
D_0_Bacteria_D_1_Proteobacteria_D_2_Deltaproteobacteria_D_3_Bdellovibrionales_D_4_Bdellovibrionaceae_D_5_Sesolobus	1.4%	0.4%	0.4%	0.3%	0.2%	0.1%	0.2%	0.2%	0.1%	1.8%	0.6%	0.2%	0.3%	0.1%	0.3%
D_0_Bacteria_D_1_Bacteroidetes_D_2_Cytophagae_D_3_Order_IHJ_D_4_Unknown_Family_D_5_Balboa	1.2%	0.1%	15.4%	0.1%	0.1%	0.1%	0.1%	0.2%	0.						

**Table S7.** Statistical significance test based on unweighted UniFrac distance matrix which obtained from beta diversity analysis

		anosim		adonis	
		<i>R</i> statistic	<i>p</i> -value	<i>R</i> <sup>2</sup>	<i>p</i> -value
bacteria	Group	0.5137**	0.007**	0.5773**	0.003**
	pH	0.1531	0.070	0.0949*	0.016*
	Phase	-0.0049	0.493	0.0741	0.625
	Temperature	0.5257**	0.002**	0.2001**	0.001**
archaea	Group	0.3255	0.050	0.5963*	0.024*
	pH	0.2297*	0.029*	0.1107*	0.034*
	Phase	0.2284*	0.020*	0.1142*	0.022*
	Temperature	0.1967	0.101	0.1948*	0.038*
methanogen	Group	0.3176*	0.031*	0.6302*	0.017*
	pH	0.0378	0.280	0.1054	0.090
	Phase	0.0894	0.115	0.0964	0.147
	Temperature	0.3421*	0.016*	0.2430**	0.003**

Scores with *p*-value less than 0.05 were labeled with one star, scores with *p*-value less than 0.01 were labeled with two stars.

**Table S8.** Mantel test based on the beta diversity results by unweighted & weighted UniFrac matrix and Bray-Curtis (non-phylogenetic) matrix measurement. The aqueous and oil phase samples were analyzed separately. The physiochemical parameter distance matrices were also separately used according to phase difference. The significant scores ( $p$ -value<0.05) were highlighted.

	DM1	DM2	Mantel r statistic	p-value
aqueous phase bacteria	unweighted unifrac_dm	aqueous phase parameter 1	0.4081	0.176
	unweighted unifrac_dm	aqueous phase parameter 2	<b>0.64753</b>	<b>0.013</b>
	unweighted unifrac_dm	aqueous phase parameter 3	0.28669	0.081
	unweighted unifrac_dm	aqueous phase parameter 4	-0.27129	0.203
	unweighted unifrac_dm	aqueous phase parameter 5	-0.16333	0.457
	unweighted unifrac_dm	aqueous phase parameter 6	-0.19444	0.15
	unweighted unifrac_dm	aqueous phase parameter 7	-0.23419	0.277
	unweighted unifrac_dm	aqueous phase parameter 8	-0.12684	0.667
	unweighted unifrac_dm	aqueous phase parameter 9	-0.24162	0.239
	unweighted unifrac_dm	aqueous phase parameter 10	<b>0.7289</b>	<b>0.018</b>
	unweighted unifrac_dm	aqueous phase parameter 11	-0.19852	0.386
	unweighted unifrac_dm	aqueous phase parameter 12	-0.11009	0.629
	unweighted unifrac_dm	aqueous phase parameter 13	-0.05797	0.812
	unweighted unifrac_dm	aqueous phase parameter 14	0.1986	0.317
	unweighted unifrac_dm	aqueous phase parameter 15	0.25858	0.163
	unweighted unifrac_dm	aqueous phase parameter 16	0.24449	0.263
	weighted unifrac_dm	aqueous phase parameter 1	0.33455	0.363
	weighted unifrac_dm	aqueous phase parameter 2	0.33405	0.352
	weighted unifrac_dm	aqueous phase parameter 3	-0.0151	0.974
	weighted unifrac_dm	aqueous phase parameter 4	-0.15934	0.652
	weighted unifrac_dm	aqueous phase parameter 5	-0.08061	0.751
	weighted unifrac_dm	aqueous phase parameter 6	0.02407	0.959
	weighted unifrac_dm	aqueous phase parameter 7	-0.092	0.72
	weighted unifrac_dm	aqueous phase parameter 8	-0.06287	0.93
	weighted unifrac_dm	aqueous phase parameter 9	-0.10384	0.795
	weighted unifrac_dm	aqueous phase parameter 10	<b>0.94397</b>	<b>0.006</b>
	weighted unifrac_dm	aqueous phase parameter 11	-0.2112	0.314
	weighted unifrac_dm	aqueous phase parameter 12	-0.04413	0.899
	weighted unifrac_dm	aqueous phase parameter 13	-0.05078	0.81
	weighted unifrac_dm	aqueous phase parameter 14	-0.06254	0.712
	weighted unifrac_dm	aqueous phase parameter 15	0.00921	0.93
	weighted unifrac_dm	aqueous phase parameter 16	<b>0.59095</b>	<b>0.044</b>
	bray_curtis_dm	aqueous phase parameter 1	-0.11603	0.703
	bray_curtis_dm	aqueous phase parameter 2	0.09572	0.73
	bray_curtis_dm	aqueous phase parameter 3	-0.13263	0.438
	bray_curtis_dm	aqueous phase parameter 4	-0.08298	0.797
bray_curtis_dm	aqueous phase parameter 5	0.15813	0.643	
bray_curtis_dm	aqueous phase parameter 6	0.25085	0.358	
bray_curtis_dm	aqueous phase parameter 7	0.24613	0.609	
bray_curtis_dm	aqueous phase parameter 8	0.25904	0.306	
bray_curtis_dm	aqueous phase parameter 9	0.03822	0.981	
bray_curtis_dm	aqueous phase parameter 10	<b>0.43431</b>	<b>0.011</b>	
bray_curtis_dm	aqueous phase parameter 11	0.30085	0.276	
bray_curtis_dm	aqueous phase parameter 12	0.34957	0.303	
bray_curtis_dm	aqueous phase parameter 13	0.40306	0.106	
bray_curtis_dm	aqueous phase parameter 14	<b>0.47986</b>	<b>0.044</b>	
bray_curtis_dm	aqueous phase parameter 15	<b>0.47202</b>	<b>0.028</b>	
bray_curtis_dm	aqueous phase parameter 16	-0.04687	0.884	
oil phase bacteria	unweighted unifrac_dm	oil phase parameter 1	0.01351	0.97
	unweighted unifrac_dm	oil phase parameter 2	0.3428	0.153
	unweighted unifrac_dm	oil phase parameter 3	0.26224	0.198
	unweighted unifrac_dm	oil phase parameter 4	0.10013	0.789
	unweighted unifrac_dm	oil phase parameter 5	0.13235	0.763
	unweighted unifrac_dm	oil phase parameter 6	0.39099	0.109
	weighted unifrac_dm	oil phase parameter 1	-0.20549	0.561
	weighted unifrac_dm	oil phase parameter 2	-0.01431	0.973
	weighted unifrac_dm	oil phase parameter 3	-0.17587	0.434
	weighted unifrac_dm	oil phase parameter 4	0.60031	0.073
	weighted unifrac_dm	oil phase parameter 5	0.62552	0.054
	weighted unifrac_dm	oil phase parameter 6	0.24391	0.348
	bray_curtis_dm	oil phase parameter 1	-0.01036	0.95
	bray_curtis_dm	oil phase parameter 2	0.24591	0.297
	bray_curtis_dm	oil phase parameter 3	0.14685	0.627
	bray_curtis_dm	oil phase parameter 4	0.23029	0.259
	bray_curtis_dm	oil phase parameter 5	0.36859	0.054
	bray_curtis_dm	oil phase parameter 6	<b>0.50466</b>	<b>0.018</b>

	DM1	DM2	Mantel r statistic	p-value
aqueous phase archaea	unweighted unifrac_dm	aqueous phase parameter 1	-0.1562	0.679
	unweighted unifrac_dm	aqueous phase parameter 2	-0.07316	0.806
	unweighted unifrac_dm	aqueous phase parameter 3	0.20278	0.273
	unweighted unifrac_dm	aqueous phase parameter 4	0.4013	0.079
	unweighted unifrac_dm	aqueous phase parameter 5	0.19431	0.417
	unweighted unifrac_dm	aqueous phase parameter 6	-0.16588	0.552
	unweighted unifrac_dm	aqueous phase parameter 7	-0.17779	0.483
	unweighted unifrac_dm	aqueous phase parameter 8	-0.12593	0.785
	unweighted unifrac_dm	aqueous phase parameter 9	-0.24733	0.241
	unweighted unifrac_dm	aqueous phase parameter 10	-0.19016	0.509
	unweighted unifrac_dm	aqueous phase parameter 11	-0.16362	0.497
	unweighted unifrac_dm	aqueous phase parameter 12	0.19952	0.436
	unweighted unifrac_dm	aqueous phase parameter 13	0.13495	0.592
	unweighted unifrac_dm	aqueous phase parameter 14	-0.00465	0.984
	unweighted unifrac_dm	aqueous phase parameter 15	0.07193	0.714
	unweighted unifrac_dm	aqueous phase parameter 16	-0.24024	0.403
	weighted unifrac_dm	aqueous phase parameter 1	0.51684	0.13
	weighted unifrac_dm	aqueous phase parameter 2	0.47496	0.117
	weighted unifrac_dm	aqueous phase parameter 3	<b>0.28173</b>	<b>0.06</b>
	weighted unifrac_dm	aqueous phase parameter 4	0.02559	0.931
	weighted unifrac_dm	aqueous phase parameter 5	0.15647	0.505
	weighted unifrac_dm	aqueous phase parameter 6	-0.06453	0.881
	weighted unifrac_dm	aqueous phase parameter 7	-0.08097	0.663
	weighted unifrac_dm	aqueous phase parameter 8	-0.15358	0.598
	weighted unifrac_dm	aqueous phase parameter 9	0.03186	0.882
	weighted unifrac_dm	aqueous phase parameter 10	-0.32541	0.144
	weighted unifrac_dm	aqueous phase parameter 11	-0.02853	0.893
	weighted unifrac_dm	aqueous phase parameter 12	-0.03156	0.879
	weighted unifrac_dm	aqueous phase parameter 13	0.15106	0.558
	weighted unifrac_dm	aqueous phase parameter 14	0.0783	0.724
	weighted unifrac_dm	aqueous phase parameter 15	-0.0195	0.92
	weighted unifrac_dm	aqueous phase parameter 16	0.01354	0.963
	bray_curtis_dm	aqueous phase parameter 1	0.06242	0.79
	bray_curtis_dm	aqueous phase parameter 2	0.10464	0.707
	bray_curtis_dm	aqueous phase parameter 3	-0.08756	0.57
	bray_curtis_dm	aqueous phase parameter 4	0.37502	0.086
bray_curtis_dm	aqueous phase parameter 5	0.11778	0.705	
bray_curtis_dm	aqueous phase parameter 6	-0.05611	0.84	
bray_curtis_dm	aqueous phase parameter 7	-0.28674	0.316	
bray_curtis_dm	aqueous phase parameter 8	-0.2785	0.256	
bray_curtis_dm	aqueous phase parameter 9	-0.41457	0.115	
bray_curtis_dm	aqueous phase parameter 10	-0.25901	0.504	
bray_curtis_dm	aqueous phase parameter 11	0.13512	0.65	
bray_curtis_dm	aqueous phase parameter 12	0.0084	0.983	
bray_curtis_dm	aqueous phase parameter 13	-0.07579	0.803	
bray_curtis_dm	aqueous phase parameter 14	-0.15899	0.446	
bray_curtis_dm	aqueous phase parameter 15	-0.17954	0.337	
bray_curtis_dm	aqueous phase parameter 16	-0.17079	0.557	
oil phase archaea	unweighted unifrac_dm	oil phase parameter 1	0.00286	0.997
	unweighted unifrac_dm	oil phase parameter 2	0.38221	0.08
	unweighted unifrac_dm	oil phase parameter 3	0.35302	0.096
	unweighted unifrac_dm	oil phase parameter 4	-0.31264	0.106
	unweighted unifrac_dm	oil phase parameter 5	-0.01977	0.919
	unweighted unifrac_dm	oil phase parameter 6	0.22681	0.351
	weighted unifrac_dm	oil phase parameter 1	0.09287	0.596
	weighted unifrac_dm	oil phase parameter 2	0.38597	0.064
	weighted unifrac_dm	oil phase parameter 3	<b>0.56527</b>	<b>0.021</b>
	weighted unifrac_dm	oil phase parameter 4	-0.15186	0.461
	weighted unifrac_dm	oil phase parameter 5	0.11992	0.539
	weighted unifrac_dm	oil phase parameter 6	0.38103	0.065
	bray_curtis_dm	oil phase parameter 1	0.01248	0.945
	bray_curtis_dm	oil phase parameter 2	0.24516	0.303
	bray_curtis_dm	oil phase parameter 3	0.35803	0.103
	bray_curtis_dm	oil phase parameter 4	0.10095	0.622
	bray_curtis_dm	oil phase parameter 5	0.27525	0.163
	bray_curtis_dm	oil phase parameter 6	0.3878	0.053

	DM1	DM2	Mantel r statistic	p-value
aqueous phase methanogen	unweighted unifrac_dm	aqueous phase parameter 1	<b>0.74583</b>	<b>0.019</b>
	unweighted unifrac_dm	aqueous phase parameter 2	<b>0.69711</b>	<b>0.007</b>
	unweighted unifrac_dm	aqueous phase parameter 3	0.14591	0.42
	unweighted unifrac_dm	aqueous phase parameter 4	0.06402	0.812
	unweighted unifrac_dm	aqueous phase parameter 5	-0.136	0.651
	unweighted unifrac_dm	aqueous phase parameter 6	-0.31355	0.228
	unweighted unifrac_dm	aqueous phase parameter 7	-0.32314	0.366
	unweighted unifrac_dm	aqueous phase parameter 8	-0.19328	0.549
	unweighted unifrac_dm	aqueous phase parameter 9	-0.35846	0.529
	unweighted unifrac_dm	aqueous phase parameter 10	0.55066	0.121
	unweighted unifrac_dm	aqueous phase parameter 11	-0.24737	0.396
	unweighted unifrac_dm	aqueous phase parameter 12	0.06981	0.836
	unweighted unifrac_dm	aqueous phase parameter 13	0.08523	0.78
	unweighted unifrac_dm	aqueous phase parameter 14	0.10257	0.683
	unweighted unifrac_dm	aqueous phase parameter 15	0.03139	0.862
	unweighted unifrac_dm	aqueous phase parameter 16	0.45712	0.074
	weighted unifrac_dm	aqueous phase parameter 1	0.55591	0.116
	weighted unifrac_dm	aqueous phase parameter 2	0.44544	0.129
	weighted unifrac_dm	aqueous phase parameter 3	<b>0.433</b>	<b>0.049</b>
	weighted unifrac_dm	aqueous phase parameter 4	0.13816	0.618
	weighted unifrac_dm	aqueous phase parameter 5	0.11883	0.643
	weighted unifrac_dm	aqueous phase parameter 6	-0.29256	0.299
	weighted unifrac_dm	aqueous phase parameter 7	-0.07679	0.74
	weighted unifrac_dm	aqueous phase parameter 8	-0.10082	0.851
	weighted unifrac_dm	aqueous phase parameter 9	0.06059	0.713
	weighted unifrac_dm	aqueous phase parameter 10	-0.28104	0.194
	weighted unifrac_dm	aqueous phase parameter 11	-0.09072	0.69
	weighted unifrac_dm	aqueous phase parameter 12	0.05044	0.797
	weighted unifrac_dm	aqueous phase parameter 13	0.21596	0.389
	weighted unifrac_dm	aqueous phase parameter 14	0.05518	0.86
	weighted unifrac_dm	aqueous phase parameter 15	-0.03789	0.868
	weighted unifrac_dm	aqueous phase parameter 16	0.11778	0.722
	bray_curtis_dm	aqueous phase parameter 1	0.18127	0.562
	bray_curtis_dm	aqueous phase parameter 2	0.17923	0.503
	bray_curtis_dm	aqueous phase parameter 3	-0.05747	0.726
	bray_curtis_dm	aqueous phase parameter 4	0.37654	0.102
bray_curtis_dm	aqueous phase parameter 5	0.11246	0.683	
bray_curtis_dm	aqueous phase parameter 6	-0.11124	0.668	
bray_curtis_dm	aqueous phase parameter 7	-0.35733	0.169	
bray_curtis_dm	aqueous phase parameter 8	-0.34202	0.23	
bray_curtis_dm	aqueous phase parameter 9	-0.48724	0.106	
bray_curtis_dm	aqueous phase parameter 10	-0.13699	0.75	
bray_curtis_dm	aqueous phase parameter 11	0.07328	0.812	
bray_curtis_dm	aqueous phase parameter 12	-0.02739	0.959	
bray_curtis_dm	aqueous phase parameter 13	-0.10301	0.688	
bray_curtis_dm	aqueous phase parameter 14	-0.15058	0.465	
bray_curtis_dm	aqueous phase parameter 15	-0.18157	0.339	
bray_curtis_dm	aqueous phase parameter 16	-0.02709	0.923	
oil phase methanogen	unweighted unifrac_dm	oil phase parameter 1	0.19509	0.564
	unweighted unifrac_dm	oil phase parameter 2	0.36776	0.101
	unweighted unifrac_dm	oil phase parameter 3	-0.10147	0.625
	unweighted unifrac_dm	oil phase parameter 4	0.46194	0.203
	unweighted unifrac_dm	oil phase parameter 5	<b>0.74692</b>	<b>0.002</b>
	unweighted unifrac_dm	oil phase parameter 6	0.23154	0.374
	weighted unifrac_dm	oil phase parameter 1	<b>0.4746</b>	<b>0.02</b>
	weighted unifrac_dm	oil phase parameter 2	<b>0.60094</b>	<b>0.025</b>
	weighted unifrac_dm	oil phase parameter 3	<b>0.44522</b>	<b>0.044</b>
	weighted unifrac_dm	oil phase parameter 4	-0.13356	0.66
	weighted unifrac_dm	oil phase parameter 5	0.1592	0.591
	weighted unifrac_dm	oil phase parameter 6	<b>0.57385</b>	<b>0.015</b>
	bray_curtis_dm	oil phase parameter 1	-0.04154	0.878
	bray_curtis_dm	oil phase parameter 2	0.19544	0.399
	bray_curtis_dm	oil phase parameter 3	0.33993	0.146
	bray_curtis_dm	oil phase parameter 4	0.078	0.67
	bray_curtis_dm	oil phase parameter 5	0.30857	0.091
	bray_curtis_dm	oil phase parameter 6	<b>0.40252</b>	<b>0.047</b>

aqueous phase parameter 1 Depth(m)  
 aqueous phase parameter 2 Temp(°C)  
 aqueous phase parameter 3 pH  
 aqueous phase parameter 4 Effective porosity (%)  
 aqueous phase parameter 5 Average permeability ( $\times 10^{-10}$   $\mu\text{m}^2$ )  
 aqueous phase parameter 6 Water flooding operation (years)  
 aqueous phase parameter 7 Cl<sup>-</sup>(mg l<sup>-1</sup>)  
 aqueous phase parameter 8 SO<sub>4</sub><sup>2-</sup>(mg l<sup>-1</sup>)  
 aqueous phase parameter 9 PO<sub>4</sub><sup>3-</sup>(mg l<sup>-1</sup>)  
 aqueous phase parameter 10 NO<sup>3-</sup>(mg l<sup>-1</sup>)  
 aqueous phase parameter 11 Na<sup>+</sup>(mg l<sup>-1</sup>)  
 aqueous phase parameter 12 K<sup>+</sup>(mg l<sup>-1</sup>)  
 aqueous phase parameter 13 Ca<sup>2+</sup>(mg l<sup>-1</sup>)  
 aqueous phase parameter 14 Mg<sup>2+</sup>(mg l<sup>-1</sup>)  
 aqueous phase parameter 15 Mn<sup>2+</sup>(mg l<sup>-1</sup>)  
 aqueous phase parameter 16 Acetate(mg l<sup>-1</sup>)

oil phase parameter 1 Depth(m)  
 oil phase parameter 2 Temp(°C)  
 oil phase parameter 3 pH  
 oil phase parameter 4 Effective porosity (%)  
 oil phase parameter 5 Average permeability ( $\times 10^{-10}$   $\mu\text{m}^2$ )  
 oil phase parameter 6 Water Flooding operation (years)

**Table S9.** Predicted functional profiles based on microbial 16S taxonomic abundance dataset. a) bacterial community functional profiles; b) archaeal community functional profiles. FTU: Fraction of OTUs that could not be mapped to KEGG organisms.

Samples	average	P10	P20	P30	P40	P50	P60	P70	P80	P90	P95	P99	FTU
FTU	0.4097	0.3716	0.2009	0.4282	0.3890	0.5215	0.2428	0.3560	0.4020	0.5324	0.3486	0.5064	0.6555
Environmental Information Processing	8.85%	8.45%	7.20%	9.38%	9.21%	7.50%	9.04%	8.69%	9.11%	9.42%	8.93%	9.52%	8.19%
Information Processing/Signal transduction/02020 Two-component system	8.29%	7.90%	9.02%	7.98%	8.15%	7.44%	7.83%	8.64%	7.96%	8.30%	7.73%	8.97%	8.49%
Information Processing/Membrane transport/01010 ABC transporters	3.29%	3.20%	3.29%	3.19%	3.23%	3.86%	3.38%	3.28%	3.32%	3.29%	3.17%	3.29%	3.16%
Metabolism/Nucleotide metabolism/02030 Purine metabolism	2.78%	2.66%	2.73%	2.58%	2.60%	3.68%	2.81%	2.84%	2.69%	2.75%	2.58%	2.76%	2.57%
Metabolism/Information Processing/Translation/03010 Ribosome	2.15%	2.14%	2.08%	1.51%	1.58%	2.83%	2.10%	2.09%	2.08%	2.25%	2.01%	2.15%	2.03%
Metabolism/Nucleotide metabolism/02040 Pyrimidine metabolism	2.05%	2.07%	2.07%	1.98%	2.06%	2.46%	2.07%	2.10%	2.02%	2.05%	1.91%	2.05%	1.90%
Environmental Information Processing/Membrane transport/03070 Bacterial secretion system	2.00%	1.96%	1.76%	2.22%	2.07%	1.69%	1.97%	1.83%	2.13%	2.02%	2.32%	1.91%	2.17%
Metabolism/Information Processing/Translation/03010 Ribosome	1.88%	1.88%	1.94%	1.74%	1.78%	1.56%	1.72%	1.78%	1.78%	1.78%	1.78%	1.78%	1.88%
Metabolism/Amino acid metabolism/03030 Arginine and proline metabolism	1.86%	1.93%	2.19%	1.84%	1.80%	1.82%	1.68%	1.81%	1.69%	1.95%	2.13%	1.77%	1.79%
Metabolism/Metabolism of cofactors and vitamins/00860 Porphyrin and chlorophyll metabolism	1.69%	1.52%	1.99%	1.62%	1.62%	1.55%	1.60%	1.64%	1.57%	1.80%	1.77%	1.71%	1.77%
Metabolism/Carbohydrate metabolism/02020 Amino sugar and nucleotide sugar metabolism	1.65%	1.58%	1.46%	1.63%	1.76%	2.03%	1.77%	1.76%	1.64%	1.63%	1.48%	1.70%	1.54%
Genetic Information Processing/Transcription/04010 RNA Polymerase	1.62%	1.67%	1.58%	1.51%	1.58%	2.09%	1.68%	1.62%	1.62%	1.62%	1.51%	1.64%	1.46%
Cellular Processes/Cell growth and death/04011 Cell cycle - Caulobacter	1.58%	1.47%	1.55%	1.50%	1.52%	1.75%	1.55%	1.56%	1.66%	1.74%	1.54%	1.52%	1.51%
Metabolism/Carbohydrate metabolism/02050 Starch and sucrose metabolism	1.54%	1.41%	1.35%	1.62%	1.63%	1.59%	1.40%	1.81%	1.15%	1.65%	1.54%	1.59%	1.55%
Metabolism/Amino acid metabolism/02040 Glycine, serine and threonine metabolism	1.47%	1.55%	1.96%	1.41%	1.36%	1.15%	1.40%	1.46%	1.42%	1.49%	1.52%	1.43%	1.41%
Cellular Processes/Cell growth and death/03010 Bacterial chemotaxis	1.45%	1.38%	1.45%	1.38%	1.38%	1.56%	1.38%	1.45%	1.46%	1.48%	1.45%	1.48%	1.50%
Metabolism/Glycan biosynthesis and metabolism/05050 Peptidoglycan biosynthesis	1.39%	1.37%	1.33%	1.35%	1.40%	1.59%	1.46%	1.41%	1.45%	1.37%	1.24%	1.42%	1.30%
Metabolism/Energy metabolism/06080 Methane metabolism	1.34%	1.16%	1.18%	1.19%	1.24%	1.71%	1.34%	1.48%	1.24%	1.42%	1.43%	1.46%	1.29%
Cellular Processes/Cell motility/02040 Flagellar assembly	1.30%	1.22%	1.16%	1.26%	1.28%	0.52%	1.53%	1.28%	1.67%	1.39%	1.61%	1.19%	1.30%
Genetic Information Processing/Transcription/04010 RNA Polymerase	1.29%	1.36%	1.29%	1.28%	1.56%	1.27%	1.25%	1.25%	1.31%	1.28%	1.23%	1.28%	1.22%
Metabolism/Carbohydrate metabolism/02030 Pyruvate metabolism	1.29%	1.31%	1.33%	1.35%	1.32%	1.21%	1.21%	1.28%	1.23%	1.26%	1.29%	1.32%	1.33%
Metabolism/Carbohydrate metabolism/02030 Glyoxylate and dicarboxylate metabolism	1.25%	1.23%	1.44%	1.25%	1.19%	1.06%	1.21%	1.17%	1.29%	1.20%	1.33%	1.17%	1.36%
Genetic Information Processing/Replication and repair/03040 Homologous recombination	1.20%	1.28%	1.88%	1.22%	1.23%	1.40%	1.13%	1.19%	1.15%	1.27%	1.23%	1.24%	1.13%
Metabolism/Carbohydrate metabolism/00010 Fructose and mannose metabolism	1.19%	1.13%	1.15%	1.38%	1.24%	1.08%	1.19%	1.20%	1.18%	1.19%	1.22%	1.18%	1.18%
Metabolism/Amino acid metabolism/02050 Alanine, aspartate and glutamate metabolism	1.07%	1.10%	1.07%	1.06%	1.06%	1.19%	1.08%	1.05%	1.07%	1.05%	1.10%	1.03%	1.04%
Metabolism/Amino acid metabolism/02070 Cysteine and methionine metabolism	1.06%	1.07%	1.07%	1.05%	1.03%	1.22%	1.03%	1.10%	1.00%	1.07%	1.03%	1.09%	1.03%
Metabolism/Amino acid metabolism/04040 Phenylalanine, tyrosine and tryptophan biosynthesis	1.06%	1.13%	1.05%	1.07%	1.03%	1.24%	0.96%	1.05%	0.92%	1.04%	1.09%	1.06%	1.04%
Genetic Information Processing/Transcription/04020 Nucleic acid excision repair	0.99%	0.95%	0.93%	1.04%	1.02%	1.06%	1.03%	0.97%	1.04%	0.97%	0.97%	1.00%	0.95%
Metabolism/Energy metabolism/00720 Carbon fixation pathways in prokaryotes	0.98%	0.98%	1.02%	0.93%	0.92%	1.10%	1.03%	0.95%	1.05%	0.93%	0.89%	0.95%	1.01%
Genetic Information Processing/Replication and repair/03010 Mismatch repair	0.95%	0.96%	0.93%	0.93%	0.93%	1.00%	0.95%	0.95%	0.95%	0.95%	0.95%	0.95%	0.95%
Metabolism/Amino acid metabolism/03030 Lysine biosynthesis	0.91%	0.96%	0.89%	0.87%	0.88%	1.09%	0.88%	0.95%	0.89%	0.88%	0.88%	0.88%	0.91%
Metabolism/Carbohydrate metabolism/00020 Pentose phosphate pathway	0.90%	0.91%	0.93%	0.93%	0.95%	0.84%	0.84%	0.99%	0.78%	0.90%	0.89%	0.95%	0.88%
Metabolism/Glycan biosynthesis and metabolism/05050 Lipopolysaccharide biosynthesis	0.89%	0.89%	0.64%	0.94%	0.88%	0.87%	0.83%	1.10%	0.80%	1.00%	0.78%	0.91%	0.85%
Metabolism/Carbohydrate metabolism/02050 Butanoic acid metabolism	0.88%	0.81%	0.85%	0.89%	0.72%	0.71%	0.83%	0.83%	0.83%	0.83%	0.83%	0.83%	0.83%
Metabolism/Carbohydrate metabolism/00010 Glycolysis / Gluconeogenesis	0.85%	0.86%	0.84%	0.88%	0.90%	0.94%	0.80%	0.96%	0.74%	0.82%	0.77%	0.91%	0.81%
Metabolism/Amino acid metabolism/03040 Histidine metabolism	0.85%	0.91%	0.92%	0.81%	0.79%	0.89%	0.82%	0.87%	0.79%	0.83%	0.87%	0.84%	0.81%
Metabolism/Metabolism of other amino acids/00480 Glutathione biosynthesis	0.84%	0.92%	1.07%	0.88%	0.84%	0.69%	0.84%	0.74%	0.89%	0.83%	0.84%	0.89%	0.81%
Metabolism/Metabolism of cofactors and vitamins/00060 Nicotinic and nicotianamide metabolism	0.76%	0.79%	0.78%	0.76%	0.76%	0.84%	0.72%	0.72%	0.73%	0.72%	0.72%	0.72%	0.73%
Metabolism/Metabolism of terpenoids and polyketides/00900 Terpenoid backbone biosynthesis	0.75%	0.74%	0.75%	0.71%	0.74%	0.96%	0.75%	0.75%	0.73%	0.72%	0.71%	0.72%	0.70%
Metabolism/lipid metabolism/00061 Fatty acid biosynthesis	0.74%	0.83%	0.87%	0.73%	0.71%	0.62%	0.80%	0.69%	0.84%	0.72%	0.76%	0.66%	0.71%
Metabolism/Amino acid metabolism/02080 Valine, leucine and isoleucine degradation	0.74%	0.82%	1.03%	0.67%	0.65%	0.45%	0.90%	0.65%	1.00%	0.68%	0.70%	0.62%	0.75%
Metabolism/Metabolism of cofactors and vitamins/00020 Ubiquinone and ubiquinol biosynthesis	0.74%	0.74%	0.74%	0.74%	0.74%	0.74%	0.74%	0.74%	0.74%	0.74%	0.74%	0.74%	0.74%
Metabolism/Amino acid metabolism/03060 Phenylalanine metabolism	0.70%	0.79%	0.85%	0.68%	0.65%	0.43%	0.80%	0.63%	0.94%	0.61%	0.59%	0.65%	0.80%
Metabolism/Metabolism of cofactors and vitamins/00770 Pantoic acid and CoA biosynthesis	0.66%	0.66%	0.63%	0.66%	0.67%	0.76%	0.63%	0.68%	0.62%	0.63%	0.67%	0.67%	0.66%
Metabolism/Carbohydrate metabolism/00020 Citrate cycle (TCA cycle)	0.65%	0.65%	0.65%	0.65%	0.62%	0.78%	0.66%	0.64%	0.68%	0.65%	0.62%	0.63%	0.63%
Metabolism/Carbohydrate metabolism/00040 Pyruvate metabolism	0.62%	0.62%	0.62%	0.62%	0.62%	0.62%	0.62%	0.62%	0.62%	0.62%	0.62%	0.62%	0.62%
Genetic Information Processing/Replication and repair/03010 Base excision repair	0.61%	0.59%	0.61%	0.61%	0.62%	0.64%	0.61%	0.60%	0.61%	0.61%	0.59%	0.61%	0.58%
Metabolism/Xenobiotics biodegradation and metabolism/00362 Benzene degradation	0.59%	0.65%	0.74%	0.58%	0.56%	0.42%	0.58%	0.53%	0.65%	0.57%	0.55%	0.66%	0.61%
Genetic Information Processing/Folding, sorting and degradation/00860 Protein export	0.59%	0.61%	0.58%	0.56%	0.57%	0.74%	0.63%	0.59%	0.61%	0.58%	0.56%	0.58%	0.54%
Human Diseases/infectious diseases: Bacterial/05111 Virus cholesterol biosynthesis cycle	0.59%	0.59%	0.59%	0.59%	0.59%	0.59%	0.59%	0.59%	0.59%	0.59%	0.59%	0.59%	0.59%
Metabolism/Metabolism of cofactors and vitamins/00790 Folate biosynthesis	0.58%	0.58%	0.56%	0.56%	0.54%	0.72%	0.58%	0.56%	0.58%	0.57%	0.61%	0.55%	0.55%
Metabolism/Amino acid metabolism/03010 Lysine degradation	0.57%	0.67%	0.60%	0.58%	0.55%	0.34%	0.72%	0.54%	0.75%	0.55%	0.63%	0.55%	0.55%
Metabolism/Metabolism of cofactors and vitamins/00330 Thiamine metabolism	0.55%	0.55%	0.55%	0.55%	0.55%	0.55%	0.55%	0.55%	0.55%	0.55%	0.55%	0.55%	0.55%
Human Diseases/infectious diseases: Bacterial/05133 Pertussis	0.55%	0.73%	0.27%	0.81%	0.69%	0.29%	0.44%	0.51%	0.51%	0.45%	0.56%	0.61%	0.63%
Metabolism/Metabolism of cofactors and vitamins/00080 Biotin metabolism	0.55%	0.63%	0.52%	0.56%	0.55%	0.54%	0.52%	0.54%	0.50%	0.55%	0.55%	0.55%	0.55%
Metabolism/Amino acid metabolism/03050 Tyrosine metabolism	0.54%	0.58%	0.63%	0.54%	0.53%	0.40%	0.54%	0.53%	0.58%	0.52%	0.52%	0.53%	0.58%
Metabolism/Metabolism of cofactors and vitamins/00040 Tetrahydrofolate metabolism	0.54%	0.54%	0.53%	0.52%	0.54%	0.55%	0.54%	0.53%	0.58%	0.52%	0.53%	0.58%	0.55%
Genetic Information Processing/Replication and repair/03030 DNA replication	0.54%	0.53%	0.53%	0.52%	0.54%	0.55%	0.54%	0.53%	0.55%	0.54%	0.54%	0.50%	0.51%
Metabolism/Amino acid metabolism/00290 Valine, leucine and isoleucine biosynthesis	0.53%	0.56%	0.56%	0.54%	0.52%	0.55%	0.45%	0.53%	0.45%	0.50%	0.53%	0.54%	0.56%
Metabolism/Energy metabolism/00920 Sulfur metabolism	0.51%	0.57%	0.49%	0.55%	0.52%	0.60%	0.39%	0.47%	0.41%	0.50%	0.58%	0.48%	0.52%
Metabolism/Carbohydrate metabolism/00040 Pentose and glucuronate interconversions	0.50%	0.49%	0.49%	0.49%	0.49%	0.49%	0.49%	0.49%	0.49%	0.49%	0.49%	0.49%	0.49%
Genetic Information Processing/Folding, sorting and degradation/04122 Sulfur relay system	0.49%	0.48%	0.40%	0.47%	0.48%	0.57%	0.54%	0.52%	0.51%	0.52%	0.51%	0.51%	0.47%
Metabolism/Carbohydrate metabolism/00052 Galactose metabolism	0.48%	0.42%	0.49%	0.49%	0.55%	0.61%	0.45%	0.57%	0.45%	0.35%	0.57%	0.44%	0.48%
Metabolism/Xenobiotics biodegradation and metabolism/00060 Aminobenzoate degradation	0.48%	0.50%	0.60%	0.48%	0.46%	0.31%	0.47%	0.44%	0.53%	0.44%	0.45%	0.46%	0.53%
Metabolism/lipid metabolism/00051 Glycerolipid metabolism	0.48%	0.48%	0.48%	0.48%	0.48%	0.48%	0.48%	0.48%	0.48%	0.48%	0.48%	0.48%	0.48%
Metabolism/Metabolism of cofactors and vitamins/00670 One carbon pool by folate	0.44%	0.45%	0.45%	0.42%	0.43%	0.53%	0.44%	0.44%	0.42%	0.45%	0.45%	0.41%	0.42%
Metabolism/lipid metabolism/00071 Fatty acid degradation	0.43%	0.47%	0.54%	0.44%	0.41%	0.30%	0.44%	0.37%	0.49%	0.41%	0.45%	0.38%	0.46%
Metabolism/Energy metabolism/00710 Carbon fixation in photosynthetic organisms	0.40%	0.39%	0.43%	0.39%	0.39%	0.44%	0.42%	0.41%	0.43%	0.38%	0.36%	0.40%	0.40%
Environmental Information Processing/Membrane transport/02060 Phosphotransferase system (PTS)	0.39%	0.39%	0.39%	0.39%	0.39%	0.39%	0.39%	0.39%	0.39%	0.39%	0.39%	0.39%	0.39%
Metabolism/Metabolism of terpenoids and polyketides/00281 Geraniol degradation	0.39%	0.48%	0.56%	0.37%	0.35%	0.16%	0.39%	0.31%	0.46%	0.37%	0.41%	0.32%	0.41%
Metabolism/Metabolism of terpenoids and polyketides/00154 Nonribosomal peptide structures	0.38%	0.40%	0.22%	0.38%	0.42%	0.19%	0.32%	0.40%	0.34%	0.50%	0.66%	0.36%	0.43%
Metabolism/Metabolism of cofactors and vitamins/00740 Riboflavin metabolism	0.37%	0.41%	0.38%	0.38%	0.37%	0.36%	0.38%	0.33%	0.39%	0.35%	0.39%	0.34%	0.36%
Metabolism/Metabolism of cofactors and vitamins/00750 Vitamin B6 metabolism	0.37%	0.41%	0.38%	0.38%</									



Metabolism/Carbohydrate metabolism/k00030 Pentose phosphate pathway	0.68%	0.66%	0.69%	0.59%	0.59%	0.59%	0.59%	0.60%	0.59%	0.59%	1.01%	0.66%	1.01%	0.59%	0.80%
Metabolism/Carbohydrate metabolism/k00020 Citrate cycle (TCA cycle)	0.68%	0.64%	0.61%	0.70%	0.70%	0.70%	0.64%	0.69%	0.66%	0.70%	0.64%	0.74%	0.64%	0.67%	0.74%
Genetic Information Processing/Replication and repair/k0140 Homologous recombination	0.65%	0.59%	0.62%	0.70%	0.69%	0.69%	0.59%	0.59%	0.58%	0.59%	0.33%	0.62%	0.33%	0.62%	0.33%
Metabolism/Xenobiotics biodegradation and metabolism/k0063 Nitroreductase degradation	0.58%	0.67%	0.69%	0.58%	0.58%	0.59%	0.53%	0.53%	0.58%	0.58%	0.91%	0.55%	0.91%	0.41%	0.39%
Metabolism/Carbohydrate metabolism/k00050 Biotin metabolism	0.55%	0.51%	0.52%	0.49%	0.49%	0.49%	0.57%	0.51%	0.56%	0.49%	0.75%	0.49%	0.75%	0.55%	0.53%
Metabolism/Carbohydrate metabolism/k00040 Riboflavin metabolism	0.55%	0.48%	0.46%	0.52%	0.52%	0.52%	0.53%	0.54%	0.52%	0.70%	0.54%	0.70%	0.54%	0.55%	0.60%
Human Diseases/Infectious diseases: Bacterial/k05134 Legionellosis	0.54%	0.54%	0.58%	0.58%	0.58%	0.58%	0.49%	0.49%	0.58%	0.58%	0.58%	0.62%	0.58%	0.58%	0.57%
Metabolism/Glycan biosynthesis and metabolism/k00510 N-Glycan biosynthesis	0.54%	0.54%	0.55%	0.51%	0.51%	0.51%	0.64%	0.53%	0.62%	0.51%	0.42%	0.54%	0.42%	0.61%	0.58%
Metabolism/Energy metabolism/k00920 Sulfur metabolism	0.53%	0.59%	0.64%	0.53%	0.54%	0.54%	0.50%	0.52%	0.50%	0.53%	0.50%	0.54%	0.50%	0.51%	0.50%
Genetic Information Processing/Folding, sorting and degradation/k0360 Proteasome export	0.53%	0.49%	0.48%	0.46%	0.46%	0.46%	0.48%	0.48%	0.48%	0.48%	0.48%	0.48%	0.48%	0.48%	0.48%
Metabolism/Amino acid metabolism/k00350 Tyrosine metabolism	0.48%	0.57%	0.60%	0.46%	0.47%	0.47%	0.40%	0.46%	0.41%	0.46%	0.48%	0.45%	0.48%	0.41%	0.55%
Metabolism/Amino acid metabolism/k00280 Valine, leucine and isoleucine degradation	0.47%	0.36%	0.34%	0.40%	0.40%	0.40%	0.38%	0.40%	0.39%	0.40%	0.84%	0.44%	0.84%	0.40%	0.57%
Genetic Information Processing/Replication and repair/k0300 DNA replication	0.46%	0.41%	0.40%	0.44%	0.44%	0.44%	0.40%	0.44%	0.41%	0.45%	0.63%	0.48%	0.63%	0.41%	0.46%
Metabolism/Energy metabolism/k0170 Carbon fixation in photosynthetic organisms	0.46%	0.46%	0.46%	0.46%	0.46%	0.46%	0.43%	0.45%	0.43%	0.46%	0.46%	0.46%	0.46%	0.46%	0.46%
Metabolism/Lipid metabolism/k00564 Glycerophospholipid metabolism	0.44%	0.38%	0.38%	0.39%	0.38%	0.38%	0.45%	0.41%	0.44%	0.39%	0.62%	0.37%	0.62%	0.41%	0.54%
Metabolism/Xenobiotics biodegradation and metabolism/k00983 Drug metabolism - other enzymes	0.44%	0.47%	0.47%	0.44%	0.44%	0.44%	0.41%	0.44%	0.42%	0.45%	0.39%	0.45%	0.39%	0.42%	0.52%
Genetic Information Processing/Folding, sorting and degradation/k0350 Proteasome	0.44%	0.45%	0.44%	0.46%	0.47%	0.47%	0.38%	0.45%	0.39%	0.47%	0.41%	0.48%	0.41%	0.39%	0.46%
Metabolism/Metabolism of other amino acids/k00450 Selenocysteine metabolism	0.41%	0.41%	0.43%	0.40%	0.40%	0.40%	0.37%	0.39%	0.38%	0.40%	0.44%	0.42%	0.44%	0.35%	0.50%
Metabolism/Metabolism of other amino acids/k00480 Glutathione metabolism	0.41%	0.68%	0.79%	0.37%	0.38%	0.38%	0.36%	0.38%	0.35%	0.38%	0.24%	0.36%	0.24%	0.33%	0.47%
Metabolism/Xenobiotics biodegradation and metabolism/k00362 Benzotene degradation	0.40%	0.35%	0.35%	0.37%	0.37%	0.37%	0.35%	0.35%	0.36%	0.66%	0.35%	0.66%	0.35%	0.37%	0.37%
Environmental Information Processing/Membrane transport/k0370 Bacterial secretion system	0.40%	0.41%	0.43%	0.39%	0.39%	0.39%	0.42%	0.39%	0.41%	0.39%	0.39%	0.37%	0.39%	0.41%	0.44%
Metabolism/Carbohydrate metabolism/k00540 Propanoate metabolism	0.40%	0.26%	0.23%	0.34%	0.34%	0.34%	0.34%	0.35%	0.36%	0.34%	0.75%	0.36%	0.75%	0.36%	0.44%
Genetic Information Processing/Transcription/k0320 RNA polymerase	0.38%	0.33%	0.32%	0.36%	0.36%	0.36%	0.36%	0.36%	0.41%	0.38%	0.41%	0.36%	0.41%	0.40%	0.39%
Metabolism/Carbohydrate metabolism/k00078 Biotin metabolism	0.37%	0.34%	0.34%	0.34%	0.34%	0.34%	0.34%	0.34%	0.35%	0.33%	0.43%	0.38%	0.43%	0.33%	0.44%
Metabolism/Xenobiotics biodegradation and metabolism/k00623 Chloroalkane and chloroalkene degradation	0.37%	0.39%	0.41%	0.40%	0.40%	0.39%	0.45%	0.38%	0.46%	0.39%	0.12%	0.39%	0.12%	0.49%	0.40%
Metabolism/Biosynthesis of other secondary metabolites/k00521 Streptomyces biosynthesis	0.34%	0.34%	0.29%	0.31%	0.31%	0.31%	0.31%	0.32%	0.31%	0.32%	0.48%	0.35%	0.48%	0.35%	0.42%
Metabolism/Metabolism of cofactors and vitamins/k00670 One carbon pool by folate	0.33%	0.33%	0.35%	0.34%	0.34%	0.34%	0.32%	0.33%	0.32%	0.34%	0.28%	0.33%	0.28%	0.32%	0.34%
Metabolism/Xenobiotics biodegradation and metabolism/k00627 Aminobenzoate degradation	0.30%	0.31%	0.30%	0.31%	0.32%	0.31%	0.28%	0.31%	0.28%	0.31%	0.32%	0.29%	0.32%	0.28%	0.31%
Genetic Information Processing/Translation/k0305 mRNA surveillance pathway	0.29%	0.30%	0.29%	0.31%	0.31%	0.31%	0.24%	0.30%	0.25%	0.31%	0.30%	0.33%	0.30%	0.26%	0.31%
Metabolism/Metabolism of cofactors and vitamins/k00750 Vitamin B6 metabolism	0.28%	0.28%	0.28%	0.28%	0.28%	0.28%	0.28%	0.28%	0.28%	0.28%	0.28%	0.28%	0.28%	0.28%	0.28%
Metabolism/Amino acid metabolism/k00310 Lysine degradation	0.27%	0.26%	0.26%	0.26%	0.26%	0.26%	0.24%	0.26%	0.24%	0.26%	0.35%	0.27%	0.35%	0.25%	0.29%
Genetic Information Processing/Replication and repair/k0340 Fancos anemia pathway	0.26%	0.45%	0.45%	0.40%	0.40%	0.40%	0.37%	0.40%	0.39%	0.45%	0.19%	0.31%	0.22%	0.35%	0.41%
Human Diseases/Infectious diseases: Bacterial/k05120 Epithelial cell signaling in Helicobacter pylori infection	0.25%	0.33%	0.36%	0.28%	0.28%	0.28%	0.24%	0.28%	0.25%	0.28%	0.29%	0.30%	0.29%	0.30%	0.26%
Metabolism/Carbohydrate metabolism/k00660 C-5-Branched dicarbonyl acid metabolism	0.25%	0.25%	0.25%	0.26%	0.26%	0.26%	0.23%	0.25%	0.24%	0.26%	0.27%	0.25%	0.27%	0.24%	0.27%
Metabolism/Xenobiotics biodegradation and metabolism/k00624 Polycyclic aromatic hydrocarbon degradation	0.25%	0.30%	0.32%	0.25%	0.25%	0.25%	0.26%	0.25%	0.25%	0.24%	0.18%	0.22%	0.18%	0.25%	0.26%
Metabolism/Lipid metabolism/k00523 Polyketide sugar unit biosynthesis	0.23%	0.19%	0.18%	0.24%	0.24%	0.24%	0.23%	0.24%	0.23%	0.24%	0.23%	0.25%	0.23%	0.25%	0.24%
Human Diseases/Infectious diseases: Bacterial/k05152 Tuberculosis	0.23%	0.26%	0.24%	0.28%	0.28%	0.28%	0.22%	0.27%	0.23%	0.28%	0.29%	0.27%	0.29%	0.24%	0.23%
Metabolism/Carbohydrate metabolism/k00040 Pentose and glucuronate interconversions	0.22%	0.21%	0.22%	0.21%	0.21%	0.21%	0.18%	0.21%	0.19%	0.21%	0.26%	0.23%	0.27%	0.20%	0.24%
Human Diseases/Infectious diseases: Bacterial/k05132 Salmonella infection	0.21%	0.29%	0.19%	0.23%	0.23%	0.23%	0.21%	0.23%	0.22%	0.23%	0.17%	0.23%	0.17%	0.22%	0.17%
Genetic Information Processing/Transcription/k0325 Basal transcription factors	0.20%	0.17%	0.18%	0.17%	0.17%	0.17%	0.18%	0.17%	0.18%	0.17%	0.23%	0.17%	0.23%	0.16%	0.17%
Metabolism/Carbohydrate metabolism/k00052 Galactose metabolism	0.19%	0.18%	0.17%	0.20%	0.20%	0.20%	0.22%	0.21%	0.21%	0.20%	0.11%	0.23%	0.11%	0.21%	0.26%
Metabolism/Lipid metabolism/k00561 Glycerolipid metabolism	0.18%	0.17%	0.18%	0.16%	0.16%	0.16%	0.19%	0.17%	0.19%	0.16%	0.17%	0.18%	0.17%	0.19%	0.27%
Metabolism/Glycan biosynthesis and metabolism/k00513 Various types of N-glycan biosynthesis	0.18%	0.18%	0.16%	0.19%	0.19%	0.19%	0.19%	0.19%	0.16%	0.19%	0.16%	0.19%	0.16%	0.19%	0.21%
Human Diseases/Infectious diseases: Bacterial/k05100 Bacterial invasion of epithelial cells	0.17%	0.12%	0.12%	0.19%	0.18%	0.18%	0.37%	0.22%	0.33%	0.18%	0.01%	0.16%	0.01%	0.30%	0.07%
Metabolism/Lipid metabolism/k00071 Fatty acid degradation	0.16%	0.08%	0.08%	0.09%	0.09%	0.09%	0.14%	0.10%	0.13%	0.09%	0.47%	0.10%	0.47%	0.13%	0.17%
Metabolism/Glycan biosynthesis and metabolism/k00540 Lysopolysaccharide biosynthesis	0.16%	0.13%	0.12%	0.16%	0.16%	0.16%	0.20%	0.16%	0.19%	0.16%	0.13%	0.16%	0.13%	0.20%	0.12%
Metabolism/Carbohydrate metabolism/k00562 Inositol phosphate metabolism	0.15%	0.16%	0.16%	0.14%	0.14%	0.14%	0.14%	0.14%	0.14%	0.14%	0.14%	0.14%	0.14%	0.14%	0.14%
Metabolism/Energy metabolism/k00196 Photosynthesis - antenna proteins	0.14%	0.16%	0.14%	0.15%	0.15%	0.15%	0.12%	0.16%	0.12%	0.15%	0.02%	0.13%	0.02%	0.18%	0.09%
Human Diseases/Infectious diseases: Parasitic/k05143 African trypanosomiasis	0.14%	0.17%	0.16%	0.15%	0.15%	0.15%	0.15%	0.15%	0.15%	0.15%	0.08%	0.14%	0.08%	0.15%	0.08%
Metabolism/Glycan biosynthesis and metabolism/k00550 Fucosylglycan biosynthesis	0.14%	0.13%	0.14%	0.13%	0.13%	0.13%	0.16%	0.14%	0.17%	0.12%	0.06%	0.20%	0.06%	0.18%	0.25%
Metabolism/Biosynthesis of other secondary metabolites/k00960 Tryptamine, pyperidine and pyridine alkaloid biosynthesis	0.13%	0.13%	0.13%	0.13%	0.13%	0.13%	0.13%	0.13%	0.13%	0.13%	0.13%	0.13%	0.13%	0.13%	0.13%
Metabolism/Metabolism of other amino acids/k00440 Phosphonate and phosphinate metabolism	0.12%	0.14%	0.14%	0.12%	0.12%	0.12%	0.14%	0.12%	0.13%	0.12%	0.09%	0.11%	0.09%	0.13%	0.10%
Metabolism/Metabolism of other amino acids/k00410 beta-Alanine metabolism	0.11%	0.19%	0.22%	0.10%	0.10%	0.10%	0.05%	0.09%	0.06%	0.10%	0.12%	0.10%	0.12%	0.06%	0.14%
Human Diseases/Cancers: Overview/k05283 Viral carcinogenesis	0.11%	0.09%	0.12%	0.09%	0.09%	0.09%	0.11%	0.09%	0.11%	0.09%	0.11%	0.09%	0.11%	0.09%	0.11%
Metabolism/Xenobiotics biodegradation and metabolism/k00628 Bisphenol degradation	0.11%	0.11%	0.11%	0.10%	0.10%	0.10%	0.11%	0.10%	0.11%	0.10%	0.06%	0.10%	0.06%	0.15%	0.12%
Metabolism/Amino acid metabolism/k00380 Tryptophan metabolism	0.11%	0.12%	0.12%	0.10%	0.10%	0.10%	0.10%	0.11%	0.10%	0.12%	0.09%	0.12%	0.09%	0.12%	0.11%
Metabolism/Biosynthesis of other secondary metabolites/k00401 Novobiocin biosynthesis	0.11%	0.11%	0.11%	0.12%	0.12%	0.12%	0.09%	0.11%	0.09%	0.12%	0.09%	0.12%	0.09%	0.12%	0.11%
Metabolism/Lipid metabolism/k00061 Fatty acid biosynthesis	0.10%	0.08%	0.08%	0.09%	0.09%	0.09%	0.08%	0.09%	0.08%	0.09%	0.08%	0.09%	0.08%	0.09%	0.08%
Metabolism/Xenobiotics biodegradation and metabolism/k00791 Atrazine degradation	0.10%	0.09%	0.09%	0.09%	0.09%	0.09%	0.07%	0.09%	0.08%	0.09%	0.13%	0.11%	0.13%	0.08%	0.12%
Metabolism/Metabolism of terpenoids and polyketides/k00281 Geraniol degradation	0.10%	0.05%	0.04%	0.05%	0.05%	0.05%	0.04%	0.05%	0.04%	0.05%	0.35%	0.05%	0.35%	0.04%	0.13%
Human Diseases/Infectious diseases: Viral/k05169 Epstein-Barr virus infection	0.10%	0.08%	0.08%	0.09%	0.09%	0.09%	0.09%	0.09%	0.09%	0.09%	0.09%	0.10%	0.09%	0.09%	0.10%
Metabolism/Glycan biosynthesis and metabolism/k00543 Chondroitin sulfate biosynthesis	0.10%	0.09%	0.09%	0.09%	0.09%	0.09%	0.09%	0.09%	0.09%	0.09%	0.09%	0.09%	0.09%	0.09%	0.09%
Metabolism/Metabolism of terpenoids and polyketides/k00903 Limonene and pinene degradation	0.09%	0.11%	0.12%	0.09%	0.09%	0.09%	0.09%	0.09%	0.09%	0.09%	0.08%	0.08%	0.08%	0.09%	0.12%
Human Diseases/Infectious diseases: Parasitic/k05146 Amebiasis	0.09%	0.09%	0.12%	0.06%	0.05%	0.05%	0.23%	0.05%	0.20%	0.06%	0.02%	0.04%	0.02%	0.17%	0.05%
Organismal Systems/Endocrine system/k04910 Insulin signaling pathway	0.09%	0.09%	0.06%	0.11%	0.11%	0.11%	0.12%	0.11%	0.11%	0.11%	0.02%	0.11%	0.02%	0.10%	0.09%
Metabolism/Metabolism of other amino acids/k00430 Tyrosine degradation	0.09%	0.09%	0.09%	0.09%	0.09%	0.09%	0.09%	0.09%	0.09%	0.09%	0.09%	0.09%	0.09%	0.09%	0.09%
Human Diseases/Infectious diseases: Bacterial/k05110 Vibrio cholerae infection	0.09%	0.12%	0.14%	0.09%	0.09%	0.09%	0.10%	0.08%	0.11%	0.09%	0.04%	0.08%	0.04%	0.10%	0.07%
Genetic Information Processing/Replication and repair/k03450 Non-homologous end-joining															

