**Supplementary file**



Figure S1Left: location of Sanggou Bay (at the edge of Shandong Province), right: location of the sampling site (red triangle) along the bay coast.

Table S1 Sediment particle size and sand proportion in the studied seepage face among four seasons.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Upper Intertidal | | Middle Intertidal | | Lower Intertidal | |
|  | Size (μm) | Sand (%) | Size (μm) | Sand (%) | Size (μm) | Sand (%) |
| Spring | 184-226 | 87.6-90.9 | 178-210 | 87.9-91.5 | 176-214 | 88.5-92.2 |
| Summer | 192-234 | 89.0-91.2 | 188-230 | 90.5-92.2 | 184-211 | 89.7-92.8 |
| Autumn | 195-214 | 90.6-93.5 | 197-224 | 90.5-92.1 | 189-215 | 90.5-92.5 |
| Winter | 204-213 | 89.4-92.4 | 189-211 | 90.3-91.6 | 196-212 | 90.2-92.6 |

Table S2 Range of microbial OTU number and alpha-diversity parameters, including Shannon index, Simpson index, Dominance and Equitability, in sediments in the seepage face among four seasons.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | OTUs | Shannon | Simpson | Dominance | Equitability |
| Spring | 1288-1411 | 7.33-8.52 | 0.008-0.04 | 0.953-0.992 | 0.709-0.815 |
| Summer | 2752-4802 | 8.89-9.51 | 0.006-0.012 | 0.988-0.994 | 0.766-0.827 |
| Autumn | 1515-3410 | 8.29-9.42 | 0.004-0.012 | 0.988-0.996 | 0.736-0.846 |
| Winter | 934-6060 | 8.03-9.58 | 0.005-0.008 | 0.992-0.995 | 0.743-0.825 |

Table S3 Classification and possible functions for 20 keystone OTUs on the range of relative abundance in four seasons

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Sequence | Phylum | Possible Genus/Species | Function | Reference |
| OTU-7 | Thaumarchaeota | *Nitrosopumilus* | Ammonia oxidizing | Qin et al., 2017 |
| OTU-21 | Bacteroidetes | *Gillisia\_hiemivivida* | Associated with N and C cycling | Bowman & Nichols, 2005 |
| OTU-22 | Proteobacteria | *Pelagibius\_litoralis* | Nitrate reduction | Choi et al., 2009 |
| OTU-249 | Actinobacteria | *Tetrasphaera\_australiensis* | Organic matter degradation and phosphate accumulation | (Maszenan et al., 2000) |
| OTU-344 | Proteobacteria | *Methyloceanibacter\_caenitepidi* | Methane oxidation | (Takeuchi et al., 2014) |
| OTU-318 | Proteobacteria | *Thioprofundum\_lithotrophicum* | Sulfur oxidation and carbon dioxide fixation | (Mori et al., 2011) |
| OTU-265 | Acidobacteria | *Acidobacteria\_Gp10* | Associated with carbon and nitrogen cycling | (Liu et al., 2017) |
| OTU-160 | Proteobacteria | *Pelagibius\_litoralis* | Nitrate reduction | (Choi et al., 2009) |
| OTU-211 | Actinobacteria | *Jatrophihabitans\_endophyticus* | Organic matter degradation | (Madhaiyan et al., 2013) |
| OTU-155 | Proteobacteria | *Anderseniella\_baltica* | Nitrate reduction | (Brettar et al., 2007) |
| OTU-222 | Acidobacteria | *Acidobacteria\_Gp21* | Associated with carbon and nitrogen cycling | (Liu et al., 2017) |
| OTU-299 | Proteobacteria | *Thioprofundum\_lithotrophicum* | Sulfur oxidation and carbon dioxide fixation | (Mori et al., 2011) |
| OTU-360 | Proteobacteria | *Thioalkalivibrio\_paradoxus* | Sulfur oxidation | (Dimitry Yu Sorokin et al., 2002) |
| OTU-285 | Proteobacteria | *Pseudoalteromonas\_marina* | Produce the biologically active metabolites | (Holmstrom & Kjelleberg, 1999) |
| OTU-67 | Proteobacteria | *Thioalkalivibrio\_sulfidiphilus* | Sulfur and nitrate oxidation | (Sorokin et al., 2012) |
| OTU-181 | Actinobacteria | *Umezawaea\_tangerina* | Organic matter degradation | (Labeda & Kroppenstedt, 2007) |
| OTU-291 | Proteobacteria | *Thioprofundum\_lithotrophicum* | Sulfur oxidation and carbon dioxide fixation | (Mori et al., 2011) |
| OTU-277 | Latescibacteria | *Latescibacteria\_genera\_incertae\_sedis* | Organic matter degradation | (Youssef et al., 2015) |
| OTU-24 | Actinobacteria | *Allokutzneria\_oryzae* | Organic matter degradation | (Duangmal et al., 2014) |
| OTU-253 | Actinobacteria | *Tetrasphaera\_australiensis* | Organic matter degradation and phosphate accumulation | (Maszenan et al., 2000) |

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