Supplementary Material

**Table 1**. Information of four types of sludge samples analyzed in this study

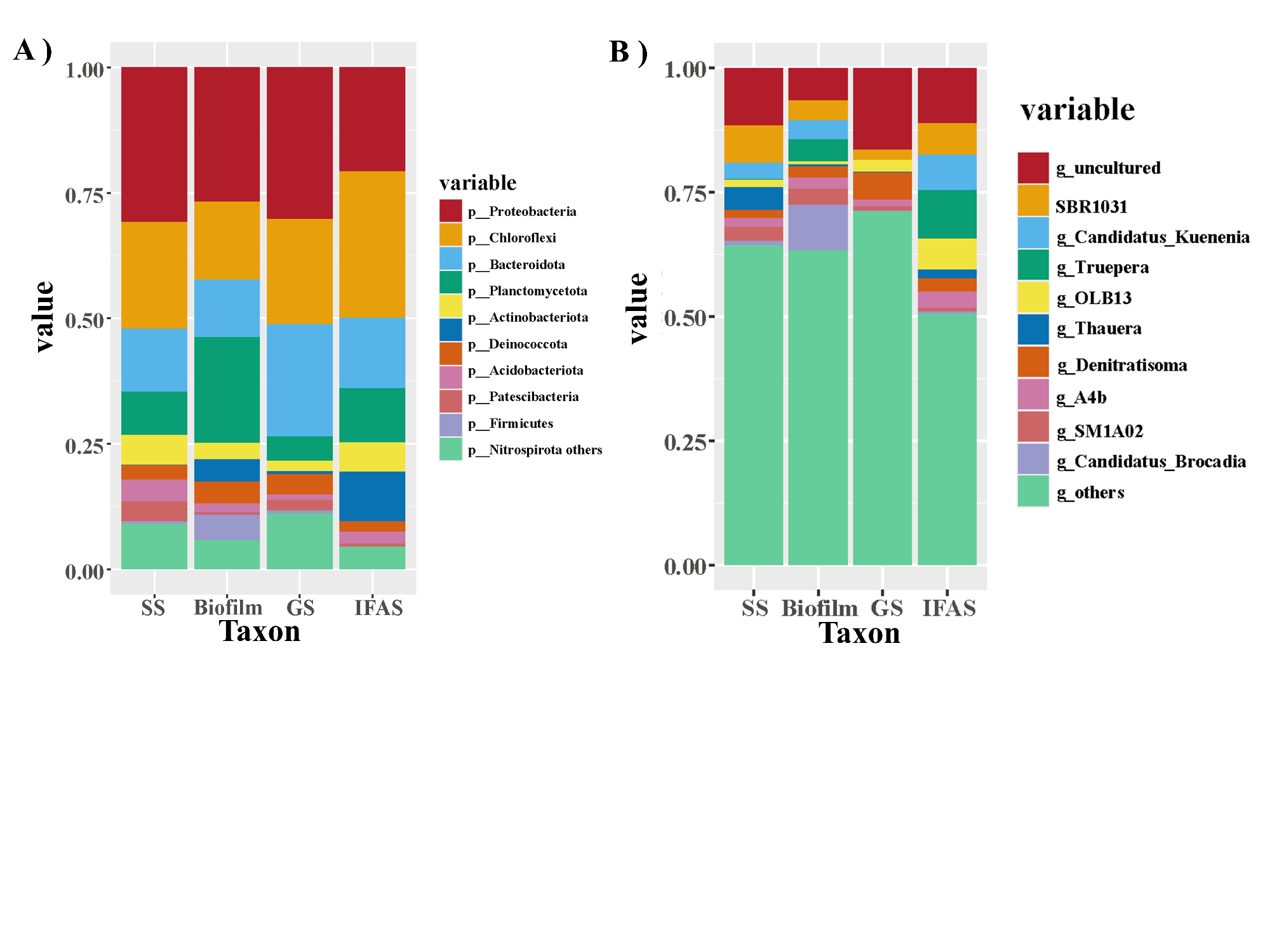
|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Article ID** | **Treatment Process** | **Location** | **Bioreactor scale** | **Bioreactor Number** | **Sequencing Region** | **Sample Number** | **Reference** |
| 1 | SBR | China: Guangdong | Lab | 1 | V3- V4 | 4 | (Yan et al., 2020) |
| 2 | SBR | China: Beijing | Lab | 1 | V3- V4 | 3 | (Cao et al., 2019) |
| 3 | SBRs、SBRo | China: Shenzhen | Lab | 2 | V4 | 1 | (Sun et al., 2018) |
| 4 | CSTR | China: Nanjing | Lab | 2 | V3- V4 | 3 | (Zhang et al., 2022b) |
| 5 | PN-SBR | Spain: Catalonia | Lab | 1 | - | 3 | (Gabarró et al., 2014) |
| 6 | Up-flow fixed-bed anammox reactor | Japan: Tokyo | Lab | 1 | - | 4 | (Suenaga et al., 2021) |
| 7 | Plexiglass | China: Nanjing | Lab | 1 | V3- V4 | 71 | (Niu et al., 2022) |
| 8 | SBBR | China: Chongqing | Lab | 1 | - | 5 | (Hong et al., 2022) |
| 9 | SBR | China: Shenzhen | Lab | 1 | - | 4 | (Miao et al., 2017) |
| 10 | UASB | China: Beijing | Lab | 1 | V3- V4 | 1 | (Wang et al., 2019a) |
| 11 | UASB | China: Beijing | Lab | 1 | V3- V4 | 3 | (Zhu et al., 2018) |
| 12 | Plexiglass | China: Shanghai | Lab | 1 | - | 4 | (Zhuang et al., 2020) |
| 13 | EPD-SBR, UASB, N-SBR | China: Beijing | Lab | 3 | V3- V4 | 3 | (Ji et al., 2018) |
| 14 | CR-SBR+ PN/A-USB+ PD/A-USB | China: Beijing | Lab | 1 | - | 6 | (Zhang et al., 2022a) |
| 15 | Continuous Flow Reactor | China: Beijing | Lab | 1 | - | 3 | (Gao et al., 2023) |
| 16 | SNAD-IFAS | China: Dalian | Lab | 1 | V3- V4 | 6 | (Wang et al., 2018) |
| 17 | PDN-Anammox Biofilter | China: Beijing | Lab | 1 | - | 2 | (Cui et al., 2020) |
| 18 | Step-feed A/O Bioreactor | China: Beijing | Lab | 1 | V3- V4 | 1 | (Gao et al., 2022) |
| 19 | UASB | China: Beijing | Lab | 1 | - | 1 | (Xu et al., 2020) |
| 20 | SBR | China: Beijing | Lab | 1 | V3- V4 | 2 | (Miao et al., 2018) |
| 21 | PNA-SBR | Spain: Catalonia | Lab | 1 | V4 | 3 | (Akaboci et al., 2018) |
| 22 | (SBRs) | Beijing 100124, PR China | Lab | 1 | V3- V4 | 4 | (Wang et al., 2019b) |
| 23 | Anammox-UASB | Beijing 100124，PR China | Lab | 1 | V4 | 6 | (Gong et al., 2020) |
| 24 | SBR | Beijing 100048, China | Lab | 1 | V4 | 6 | (Lv et al., 2020) |
| 25 | IFAS | Beijing 100124, PR China | Lab | 1 | - | 9 | (Yang et al., 2019) |
| 26 | IFAS | Harbin 150090, China | Lab | 1 | V3- V4 | 2 | (Yang et al., 2017) |
| 27 | SNAD-IFAS | Qingdao 266071, PR China | Lab | 1 | - | 7 | (Yang et al., 2017) |
| 28 | A/O | Beijing University of Technology, Beijing, China; | Lab | 1 | - | 1 | (Du et al., 2021) |
| 29 | PNABR | Beijing 100124, PR China | Lab | 1 | - | 2 | (Jiang et al., 2020) |
| 30 | NWMBR | Shanghai Jiaotong University, PR China | Lab | 1 | V4 | 2 | (Ren et al., 2018) |
| 31 | PBBR | Hongkong，China | Lab | 1 | V4 | 11 | (Li et al., 2021) |
| 32 | SBR | China; | Lab | 1 | V4 | 5 | (Huang and Wu, 2020) |
| 33 | PN/A | Beijing 100022, China | Lab | 1 | V3- V4 | 16 | (Yang et al., 2021) |
| 34 | PN/A，A/A/O | Beijing 100124, PR China | Lab | 2 | V3- V4 | 4 | (Gao et al., 2021) |

**Table 2**. Accession numbers of the 16S rRNA gene sequencing datasets analyzed in this study

|  |  |
| --- | --- |
| **Article ID** | **Accession numbers** |
| 1 | SRR11210586, SRR11210587, SRR11210588, SRR11210589 |
| 2 | SRR5885315, SRR5885316, SRR5885317 |
| 3 | SRR4238043 |
| 4 | [SRR19744794](https://trace.ncbi.nlm.nih.gov/Traces?run=SRR19744794), [SRR19744795](https://trace.ncbi.nlm.nih.gov/Traces?run=SRR19744795), [SRR19744796](https://trace.ncbi.nlm.nih.gov/Traces?run=SRR19744796) |
| 5 | SRR1019211, SRR1019209, SRS494429 |
| 6 | DRR189466, DRR189465, DRR189464, DRR189463 |
| 7 | SRR15377087- SRR15377158 |
| 8 | SRR19577258- SRR19577262 |
| 9 | SRR4004225- SRR4004228 |
| 10 | SRR6448375 |
| 11 | SRR6448186- SRR6448188 |
| 12 | SRR10810250, SRR10807893, SRR10807626, SRR10803493 |
| 13 | SRR5879570, SRR6179223, SRR5879569 |
| 14 | SRR19668067, SRR19668068, SRR19668069, SRR19668070, SRR19668071, SRR19668072 |
| 15 | SRR19592836- SRR19592838 |
| 16 | SRR6037377- SRR6037382 |
| 17 | SRR10201390, SRR10201391 |
| 18 | SUB9234646 |
| 19 | SRR10064596 |
| 20 | SRR6056688, SRR6056752 |
| 21 | SRR6012558- SRR6012560 |
| 22 | SRR8359314, SRR8359315, SRR8359316 and SRR8359317 |
| 23 | SRR11212297- SRR11212302 |
| 24 | SRR10695693, SRR10695692, SRR10695691, SRR10695690, SRR10695689, SRR10695688 |
| 25 | SRR6891810- SRR6891818 |
| 26 | SRR4297636, SRR4297637 |
| 27 | SRR10199657, SRR10230800, SRR10230803, SRR10230799, SRR10230802, SRR10230798 and SRR10230801 |
| 28 | SRR5266476 |
| 29 | SRR10609227, SRR10609228 |
| 30 | SRR5260888, SRR5260898 |
| 31 | SRR14923912- SRR14923922 |
| 32 | SRR10567086- SRR10567092 |
| 33 | SRR9943601- SRR9943606 and SRR9943609- SRR993618 |
| 34 | SRR12396692- SRR12396695 |

**Table S3**. Main genera specific to different morphologic microorganisms

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| SS | SS | Biofilm | Biofilm | GS | GS | IFAS | IFAS |
| Aquicella | 0.000905 | Brumimicrobium | 0.004408 | Meiothermus | 0.005239 | Sphingosinicella | 0.000533 |
| Cutibacterium | 0.000675 | Photobacterium | 0.001332 | mle1-8 | 0.001884 | D8A-2 | 0.000348 |
| Thermoanaerobaculum | 0.000588 | Wenzhouxiangella | 0.000505 | unclassified\_Phycisphaerae | 0.001149 | Acetomicrobium | 0.000163 |
| Mizugakiibacter | 0.000373 | UBA9983 | 0.000275 | S-70 | 0.001103 | Limnochordaceae | 0.000156 |
| Lamprocystis | 0.000291 | Vulcanibacillus | 0.000199 | unclassified\_Deinococcaceae | 0.000643 | Methyloceanibacter | 0.000156 |
| Prevotellaceae\_UCG-001 | 0.000291 | Nitriliruptoraceae | 0.000184 | CCM11a | 0.000552 | 113B434 | 9.24E-05 |
| Prevotellaceae\_NK3B31\_group | 0.000266 | Sneathiella | 0.000168 | Peptoclostridium | 0.000414 | Arsenophonus | 9.24E-05 |
| Sulfuricurvum | 0.000266 | Lutibacter | 0.000138 | unclassified\_Pirellulaceae | 0.000322 | Oligoflexales | 9.24E-05 |
| unclassified\_Chromatiaceae | 0.000266 | Dinghuibacter | 0.000122 | Rhodopirellula | 0.00023 | Cerasicoccus | 4.26E-05 |
| Desulfobacter | 0.000256 | unclassified\_Vibrionaceae | 0.000122 | Rurimicrobium | 0.00023 | unclassified\_Chthoniobacterales | 4.26E-05 |



**Fig. S1.** The relative abundance of phylum and genus in four types of sludge. (a) The relative abundances of the ten most abundant phyla of the four forms of sludge (b) the relative abundances of the ten most abundant genera of the four forms of sludge.

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