Table 1. Average acceptor and donor fluxes for each stage of the MBfR experiments.

	NO_3^--N		NO_2^--N		ClO_4^-		Electron donor (CH_4)	
stages[a]	Flux (g N/m^2-d)[b]	Electron donor consumed (mmol CH_4/m^2-d)	Flux (g N/m^2-d)	Electron donor consumed (mmol CH_4/m^2-d)	Flux (g/m^2-d)	Electron donor consumed (mmol CH_4/m^2-d)	Maximum CH_4 flux (mmol CH_4/m^2-d)[b, c]	Actual CH_4 flux (mmol CH_4/m^2-d)[b]
1	NA	0	0.10±0.001	5.97±0.06	0.02±0.002	0.29±0.03	57.9	6.26±0.06
2	NA	0	NA	0	0.05±0.006	0.82±0.09	57.9	0.82±0.09
3	0.08±0.007	6.4±0.6	NA	0	0.06±0.001	0.96±0.01	57.9	7.35±0.60
4	0.55±0.09	47.4±7.2	NA	0	0.002±0.0004	0.03±0.006	57.9	47.5±7.20
5	0.30±0.003	26.0±0.3	NA	0	0.07±0.006	1.03±0.09	86.8	27.0±0.26
6	NA	0	NA	0	0.39±0.006	5.91±0.09	86.8	5.91±0.09
7	NA	0	0.39±0.01	23.2±0.6	0.19±0.03	2.87±0.44	86.8	26.0±0.59

NA = not applicable

a: Gas pressure was 10 psi for stage 1-4, 15 psi for stage 5-7. b: Calculated from equations 2 through 4. c: Maximum CH_4 flux was calculated by Tang et al (2012), considering the $P_{m\text{-}if}$ (CH_4 pressure at the interface of membrane and liquid film) was 0, and a theoretical maximum CH_4 flux can be obtained in the liquid phase. c: 1 bar= 14.5 psi

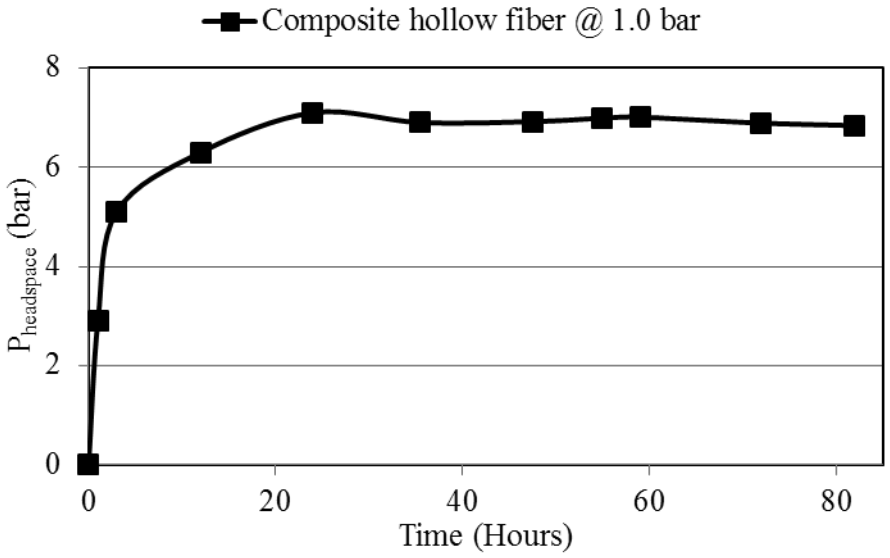

Figure 1. Headspace CH_4 pressure during the CH_4-permeation experiment. Steady state P_{hs} was achieved at ~15 hours.

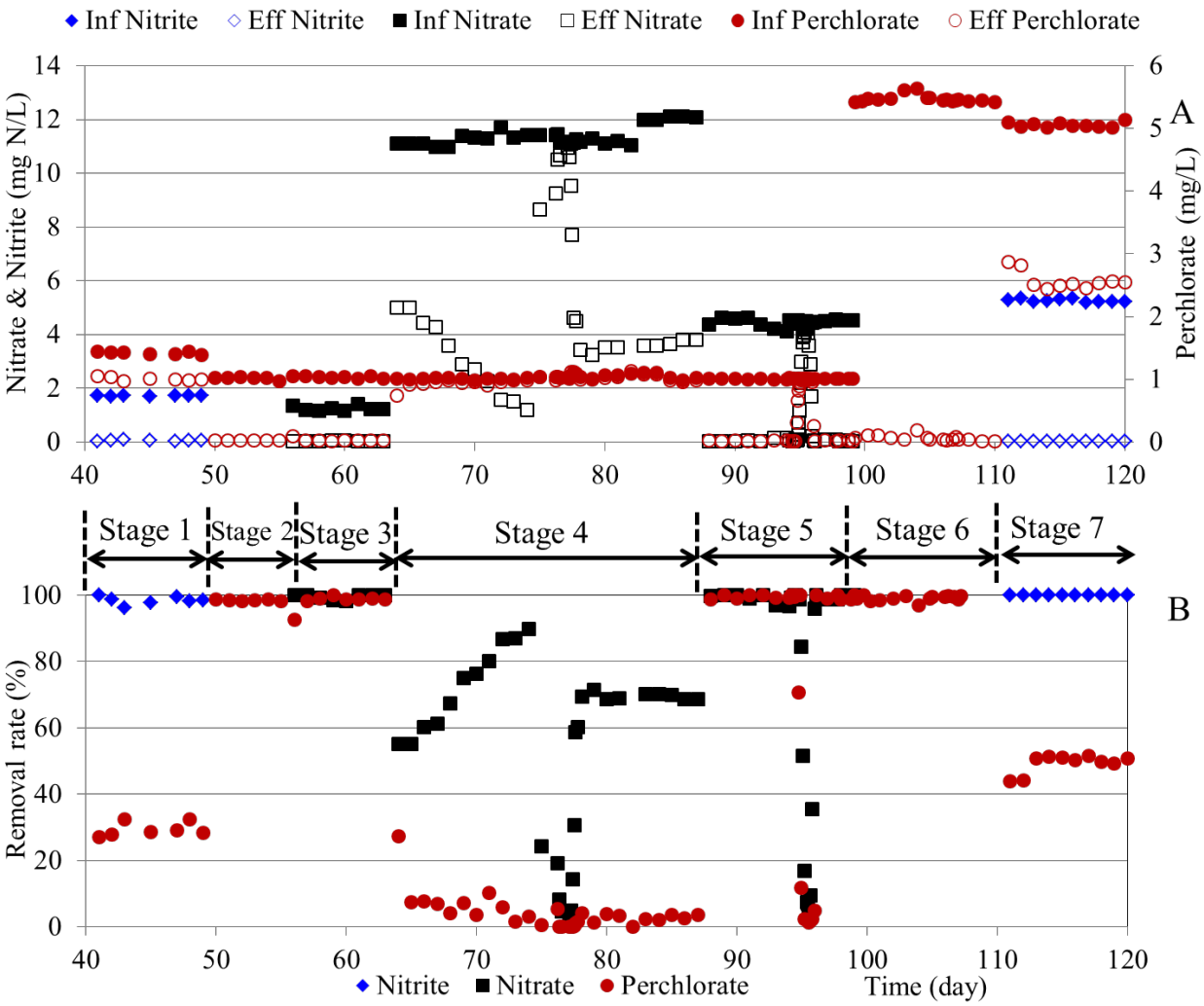

Figure 2. (A) NO_2^-, NO_3^-, and ClO_4^- concentrations in the MBfR influent and effluent. (B) NO_2^-, NO_3^-, and ClO_4^- removal percentages.

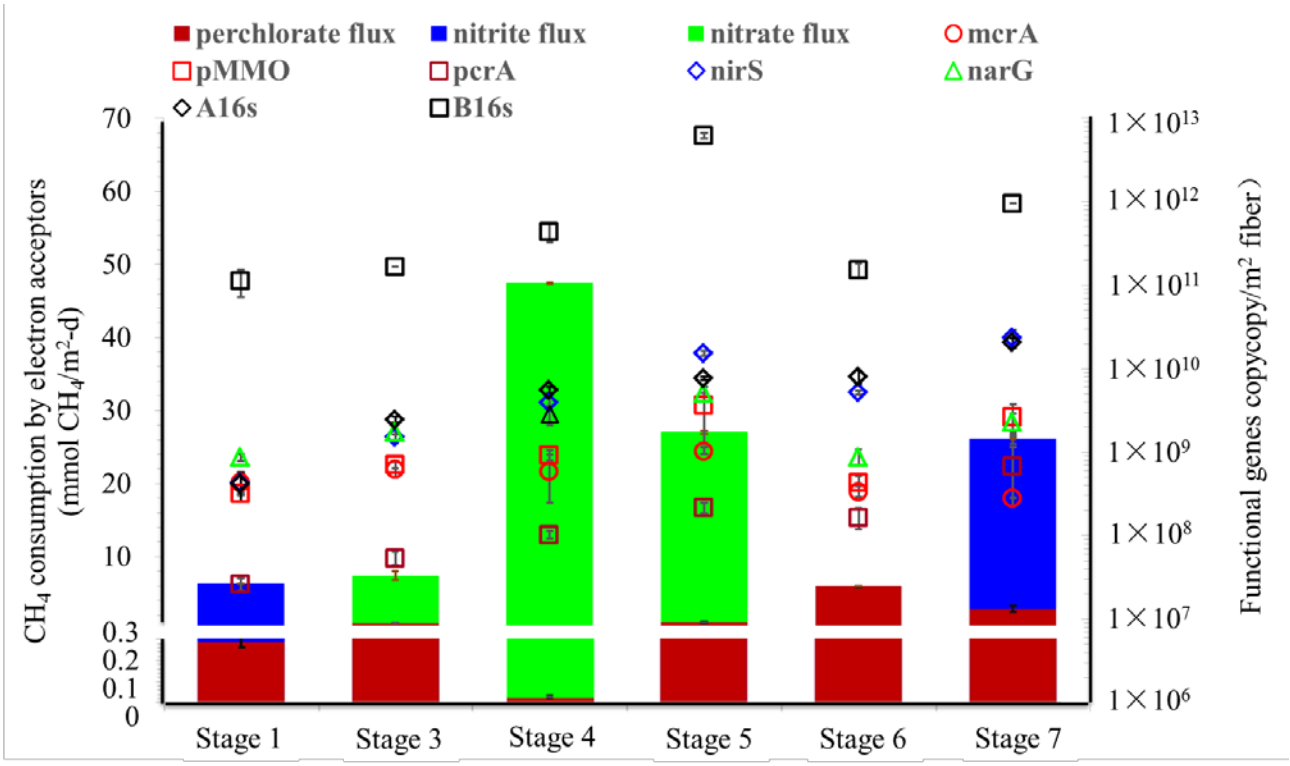

Figure 3. The average fluxes of NO_3^-, NO_2^-, and ClO_4^- along with the qPCR-based abundances of functional genes through all stages. The *narG* gene copy number in Stage 4 is plotted as open black triangle so that it can been seen within the green bar, while *narG* gene copy number in other stages are plotted as solid green triangles. Absence of bars indicates that the error is smaller than the symbol size.

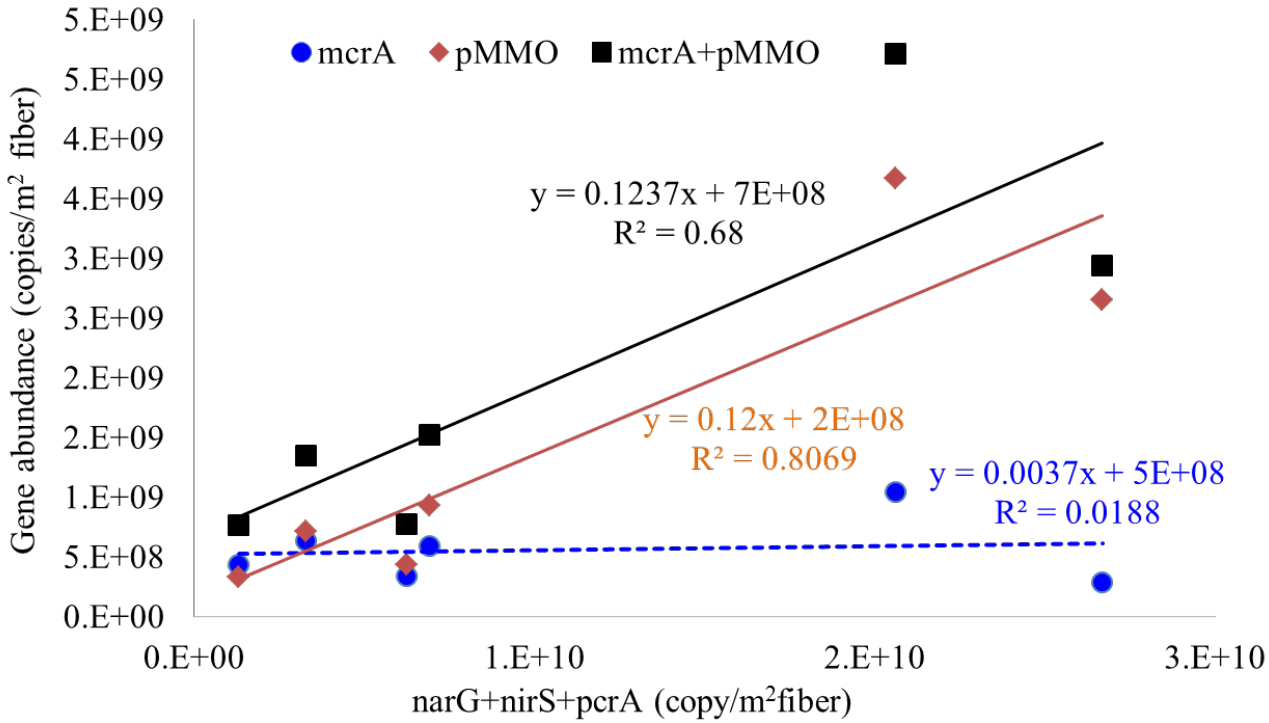

Figure 4. Linear regression of *mcrA*, *pMMO*, and *mcrA+pMMO* functional genes against the sum of *narG*, *nirS*, and *pcrA* genes.

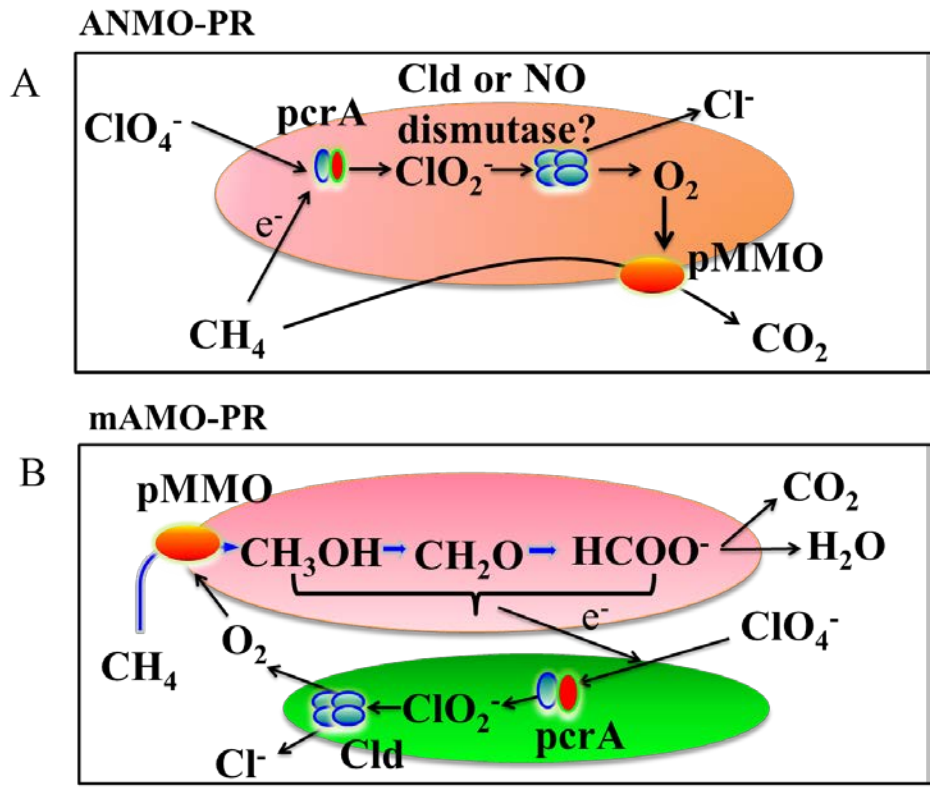

Figure 5. The potential ClO_4^- reduction pathways by the ANMO-D culture. A: ANMO-PR, Anaerobic methane oxidation coupled to perchlorate reduction, carried out by one bacterium that dismutates ClO_2^- to form Cl^- and O_2 intracellularly, with the O_2 used as a co-substrate for methane mono-oxygenation by itself (Intra-Aerobic Type); B: mAMO-PR: micro-Aerobic methane oxidation coupled to perchlorate reduction, carried out by two microorganisms: bacteria reduce ClO_4^- to Cl^- and produce O_2 extracellularly, and the O_2 is utilized by methanotrophs to oxidize methane (Extracellular micro-Aerobic Type).