SUPPORTING INFORMATION

The Bioavailable Age of DON: A New Paradigm for Explaining Diatom-Dinoflagellate Succession in Coastal Seas

Haoyu Zhang [a,b], Cui Zeng [b], Xiansheng Zhang [b], Xiulin Wang [a,b], and Keqiang Li [a,b*]

[a]*Frontiers Science Center for Deep Ocean Multispheres and Earth System, Ministry of Education, and Key Laboratory of Marine Chemistry Theory and Technology, Ocean University of China, Qingdao 266100, China*

[b]*College of Chemistry and Chemical Engineering, Ocean University of China, Qingdao 2066061, China*

Corresponding author: Keqiang Li (likeqiang@ouc.edu.cn)

Table of Contents

Text S1：Data Statistics and Analysis

The Slogistic2 growth model in Origin software (The Microcal Inc., USA) was used to fit diatom and dinoflagellate growth curves based on Chl *a* time series data :

$$Y_t = \frac{Y_f}{1 + \frac{Y_f - Y_0}{Y_0} \mathrm{e}^{\frac{-4W_{\max} t}{Y_f}}}$$

Where Y_t = biomass at time, Y_0 = initial biomass, Y_f = final biomass, $Wmax$ = growth rate constant, and t_0 = inflection time.

Modified Monod equations incorporating PN, Chl *a*, and DIN dynamics were fitted using MATLAB R2018b:

$$\frac{dDON}{dt} = -K_{up} \cdot PN \frac{DON - DON_{\min}}{K_s + DON - DON_{\min}}$$

$$\frac{dPN}{dt} = PN(k_{upDIN} \cdot \frac{DIN\text{-}DIN_{\min}}{k_{sDIN} + DIN\text{-}DIN_{\min}} + k_{upDON} \cdot \frac{DON\text{-}DON_{\min}}{k_{sDON} + DON\text{-}DON_{\min}}) - k_{de} \cdot PN$$

$$\frac{dChl\ a}{dt} = Chl\ a \cdot k_G \cdot (\frac{DIN\text{-}DIN_{\min}}{k_{sDIN} + DIN\text{-}DIN_{\min}} + \frac{DON\text{-}DON_{\min}}{k_{sDON} + DON\text{-}DON_{\min}}) - k_D \cdot (Chl\ a + Chl\ a^2)$$

DON_{min}/DIN_{min}: Minimum concentration threshold of DON/DIN (μmol/L)

PN: Particulate nitrogen concentration (μmol/L)

k_{sDON}/k_{sDIN}: Half-saturation constant for DON/DIN uptake (μmol/L)

k_{upDON}/k_{upDIN}: Uptake rate constant for DON/DIN (μmol·L^{-1} h^{-1})

k_G: Growth rate constant for diatoms and dinoflagellates (h^{-1})

k_D: Death rate constant for diatoms and dinoflagellates (μmol/L)

k_{de}: Degradation rate constant for phytoplankton detritus (μmol/L).

Table S1 Concentrations of DOM stock solution leached from chicken manure

Source of stock solution	DON	DIN	DOP	DIP
Chicken manure leachate (mmol/L)	60.7±2.7	14.2±1.2	0.02±0.002	0.3±0.017

Table S2 Initial parameters and environmental conditions of the aging experiment

Nutrient parameters	Chicken manure-derived DON culture group(mmol/L)	Seawater blank control group(μmol/L)	Environmental conditions
DIN	1.37±0.15	23.0±0.85	Daylight illumination: 10-2000 lux
DON	5.98±0.22	17.0±1.2	Salinity: 27.4‰±0.2
DOC	18.49±0.69	175.0±1.9	Temperature: 23-27 ℃
DIP	0.03±0.003	0.03±0.00	pH: 7.60±0.10
DOP	0.001±0.000	0.06±0.01	

Table S3 Assignments of infrared absorption bands for DOM during natural incubation in seawater.

Wavenumber (cm^{-1})	Functional Group Assignmen
3700-3300 cm^{-1}	－OH
3260-3200 cm^{-1}	－NH
2500-2200 cm^{-1}	－C≡CR
1680-1500 cm^{-1}	C=O/－Ar
1450-1300 cm^{-1}	－OH/－ArOH
1300-1000 cm^{-1}	－COOH/－COOR

Table S4 Sequencing quality and initial parameters

	Sample	Raw_Reads	Raw_Bases	Valid_Reads	Valid_Bases	Valid%	Q20%	Q30%	GC%
	0d-1	38390962	5.76G	37332780	5.53G	97.24	98.20	94.26	44.14
	0d-2	40050902	6.01G	39376802	5.84G	98.32	98.41	94.85	44.15
	0d-3	37111954	5.57G	36066920	5.34G	97.18	98.23	94.37	44.24
	12d-1	37695736	5.65G	36640644	5.42G	97.20	98.16	94.17	44.20
	12d-2	37526960	5.63G	36495340	5.40G	97.25	98.21	94.31	44.27
	12d-3	37283112	5.59G	36341644	5.38G	97.47	98.06	93.91	44.16
	80d-1	37109540	5.57G	36205718	5.36G	97.56	98.13	94.10	44.24
C. curvisetus	80d-2	39260926	5.89G	38421344	5.69G	97.86	98.11	94.10	44.14
	80d-3	36853798	5.53G	36025310	5.34G	97.75	98.13	94.10	44.19
	0d-1	37933292	5.69G	35424032	5.21G	93.39	97.01	95.21	54.47
P. minimum	0d-2	37557680	5.63G	31971942	4.68G	85.13	96.79	95.13	54.37
	0d-3	45134234	6.77G	38115504	5.57G	84.45	96.80	95.16	54.41

12d-1	38870826	5.83G	32393214	4.73G	83.34	96.75	95.05	54.43
12d-2	40600824	6.09G	34965330	5.12G	86.12	96.81	95.16	54.42
12d-3	41482642	6.22G	35520322	5.20G	85.63	96.88	95.25	54.40
80d-1	45112292	6.77G	41837706	6.15G	92.74	96.99	95.14	54.47
80d-2	41035116	6.16G	34915660	5.11G	85.09	96.87	95.25	54.36
80d-3	40574992	6.09G	35088418	5.14G	86.48	97.16	95.63	54.35

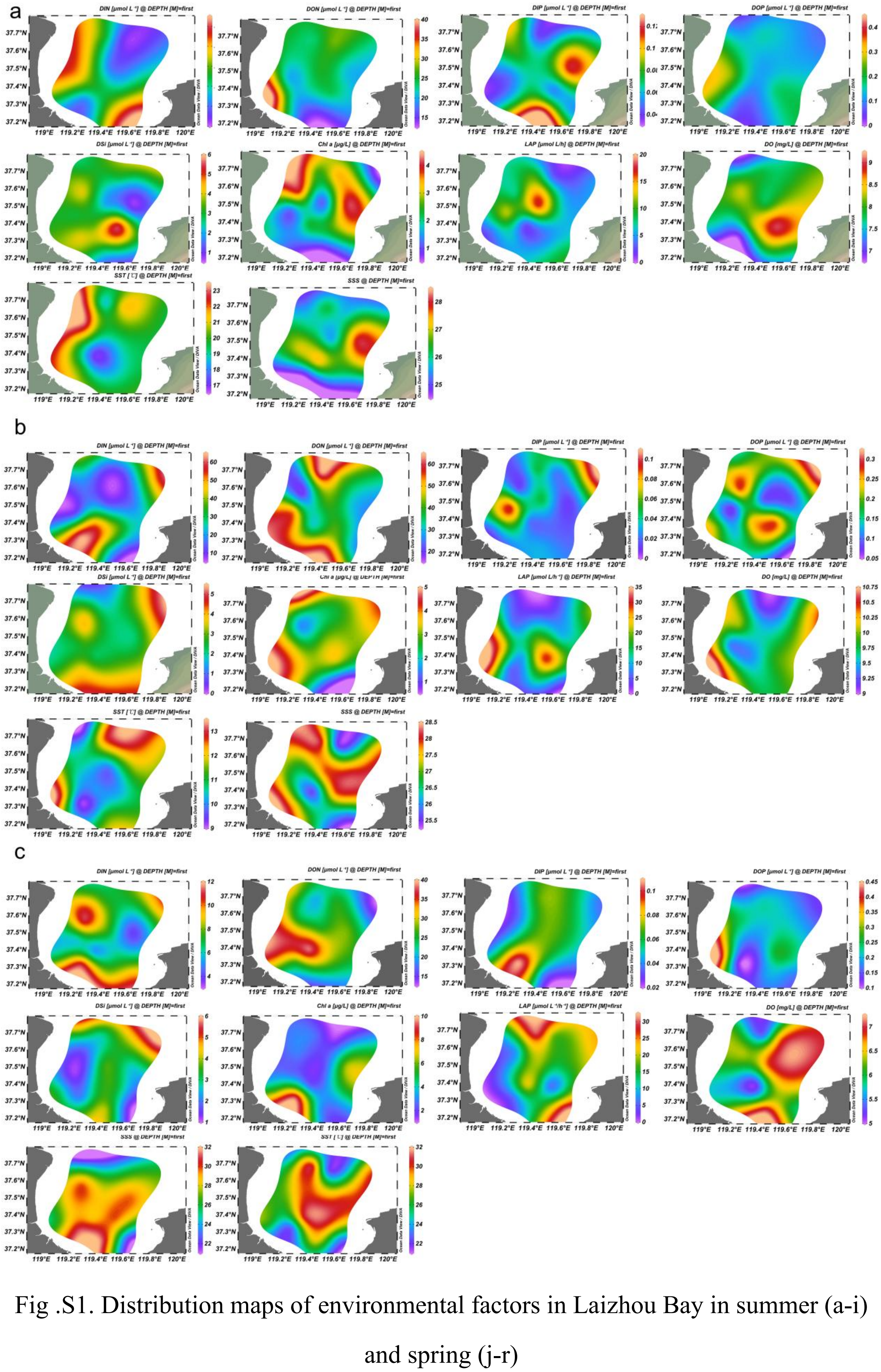

Fig .S1. Distribution maps of environmental factors in Laizhou Bay in summer (a-i) and spring (j-r)

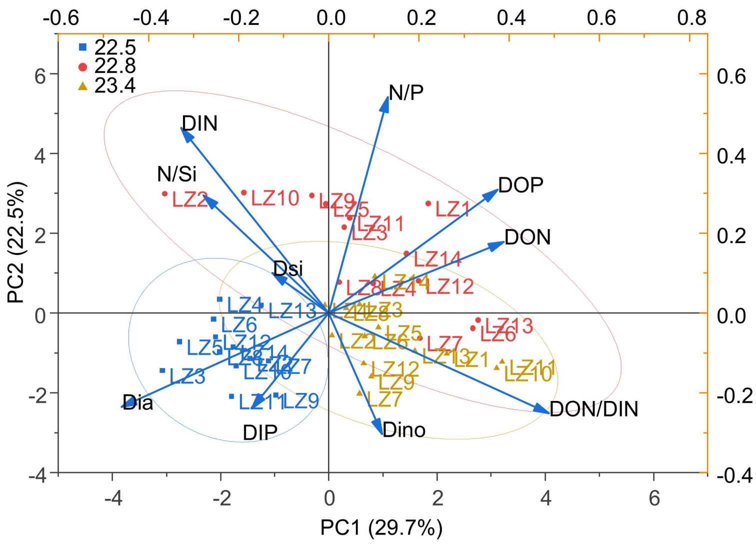

Fig .S2. RDA analyses of environmental factors and phytoplankton community in Laizhou

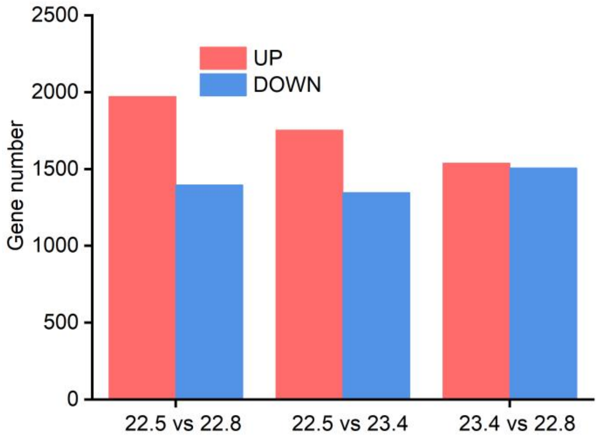

Fig .S3. Numbers of DEGs for each comparison.

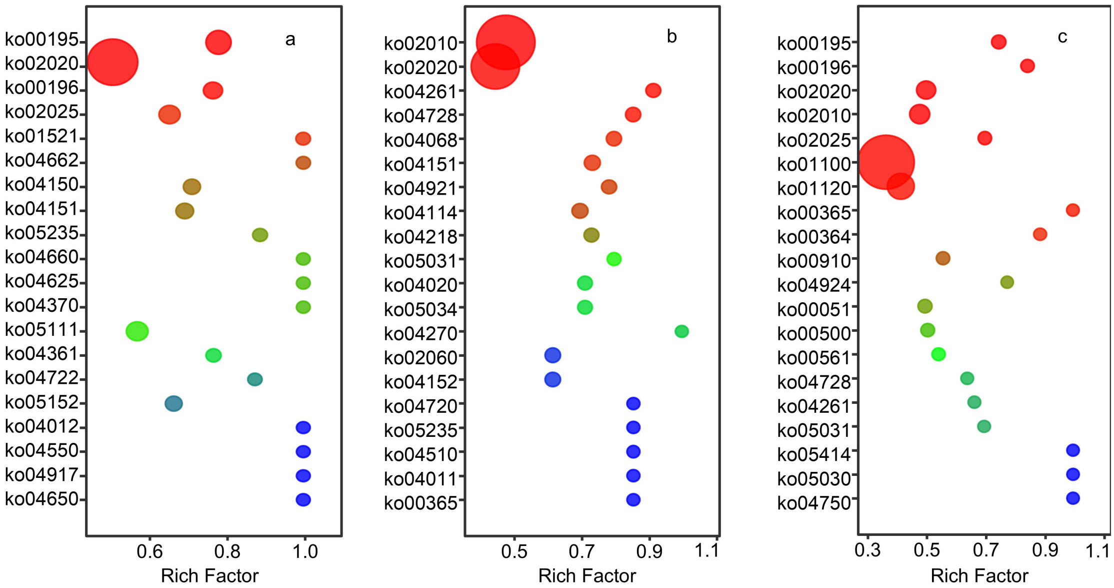

Fig .S4. KEGG enrichment in Laizhou Bay. (22.5: a , 22.8: b, 23.4: c).

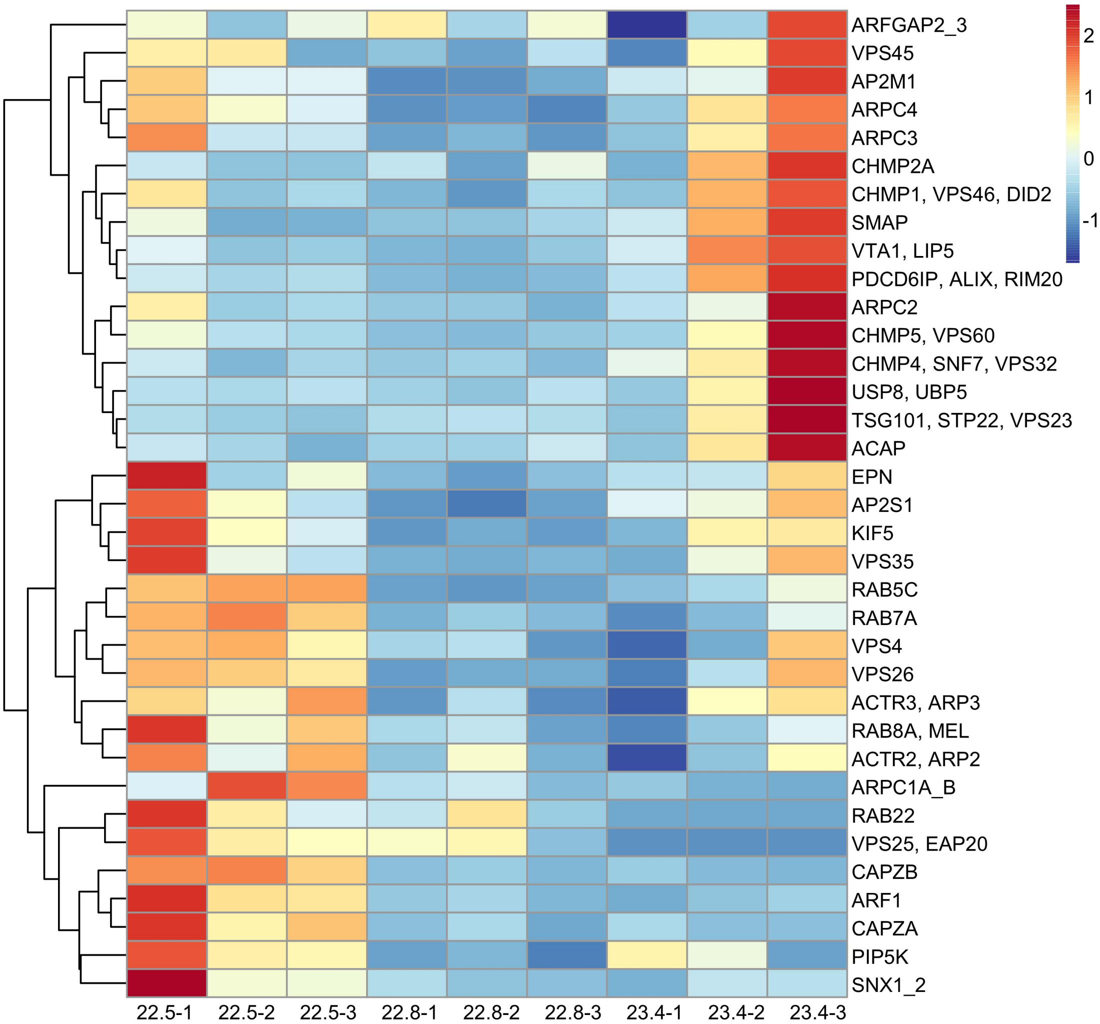

Fig .S5. Heatmap of phagocytosis gene expression in summer and spring in Laizhou Bay

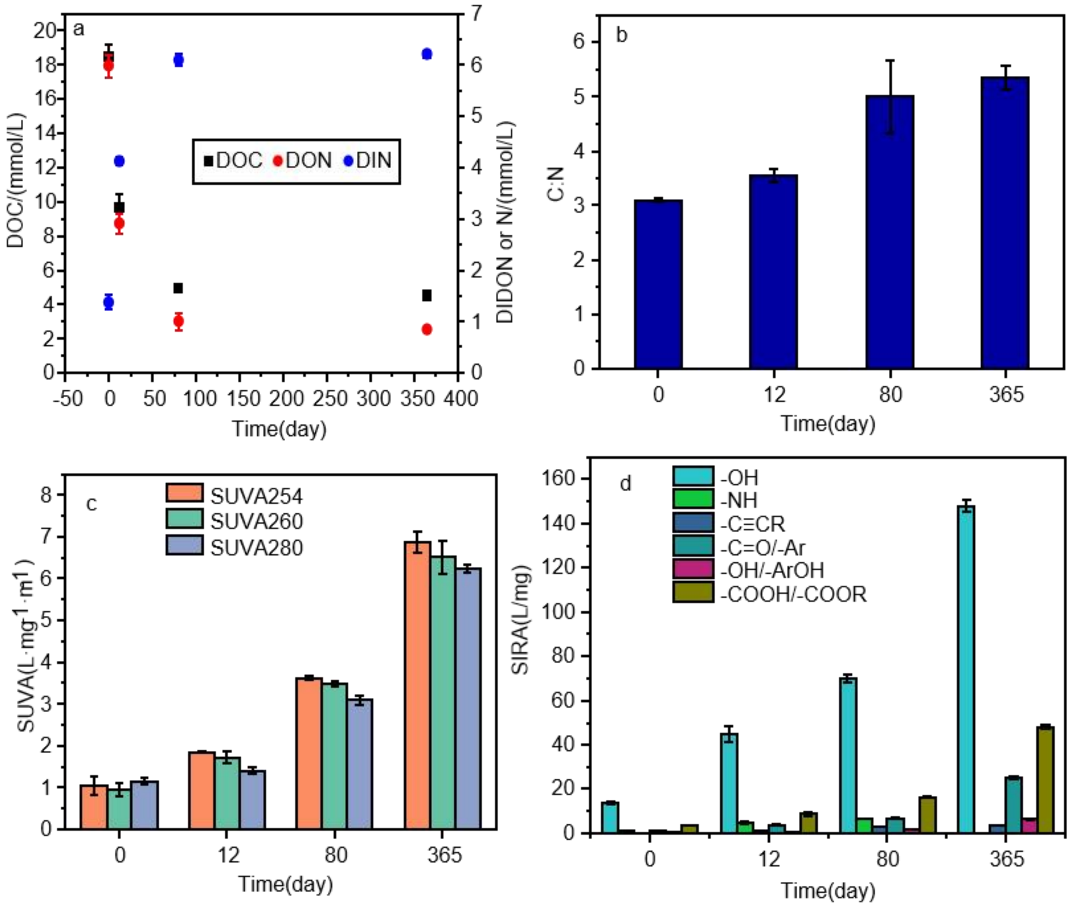

Fig .S6. Changes in nutrients, three-dimensional fluorescence, and infrared spectroscopy during PPL-DONC aging process.

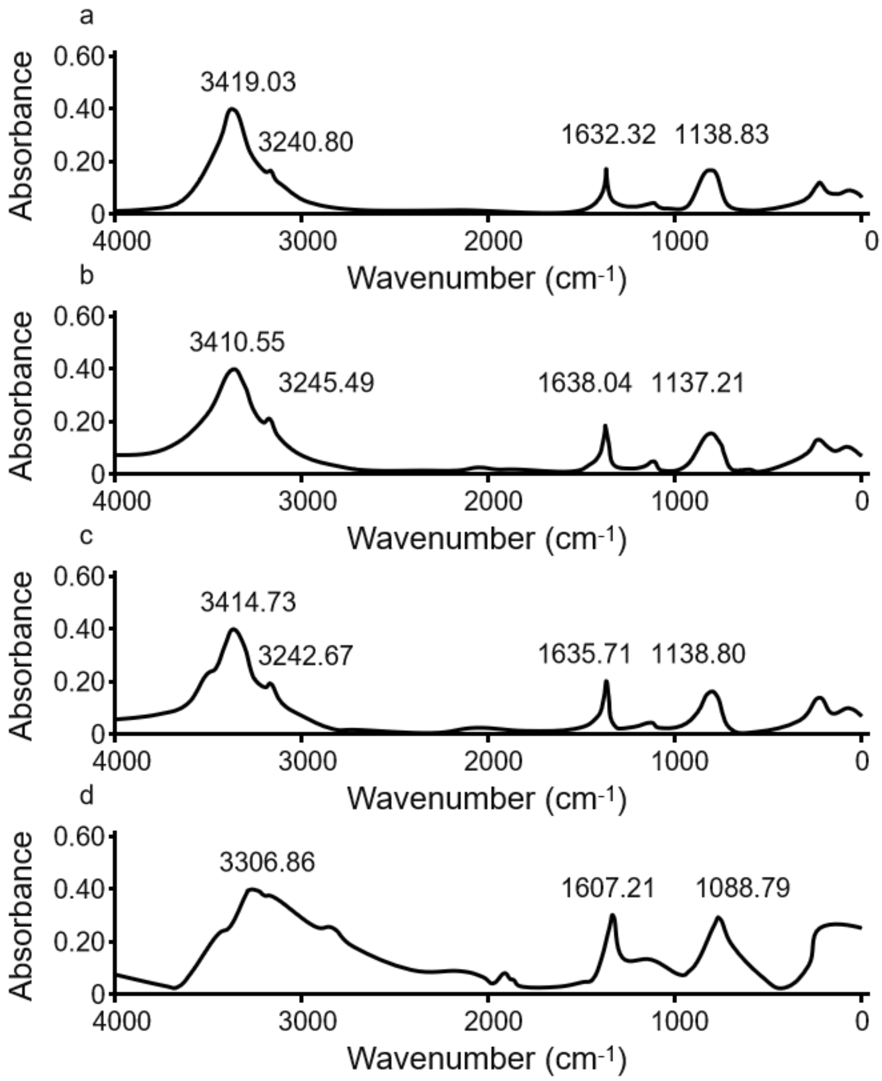

Fig .S7. Infrared spectra of DON at different aging stages (a: 0 d, b: 12 d, c: 80 d, d: 365 d)

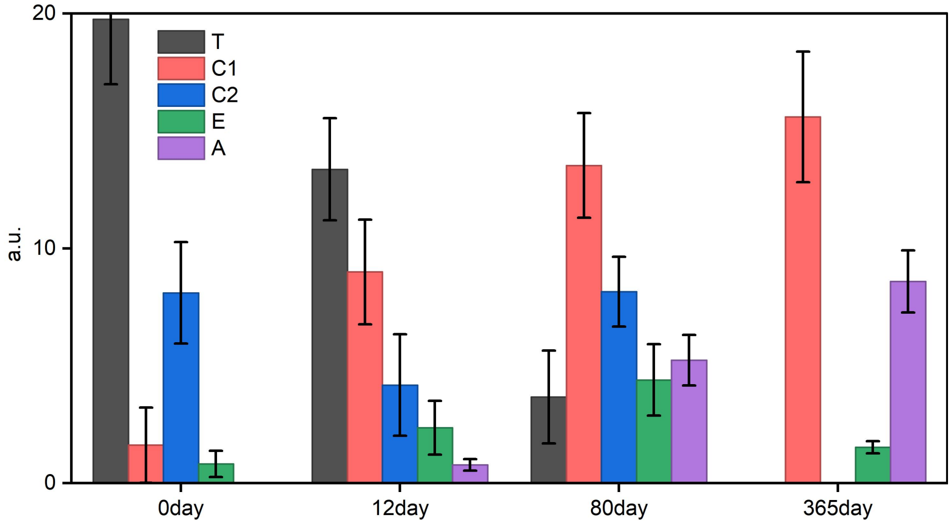

Fig .S8. Changes in EEM fluorescence component intensities of PPL-DOM during laboratory aging in natural seawater.

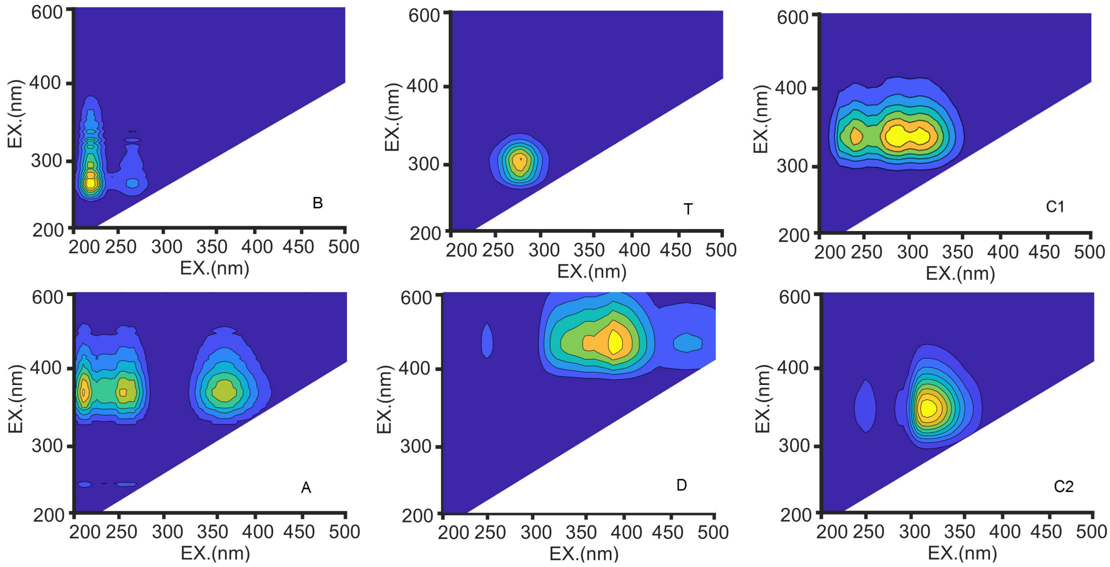

Fig .S9. Fluorescence spectra of the aged DON incubation experiment

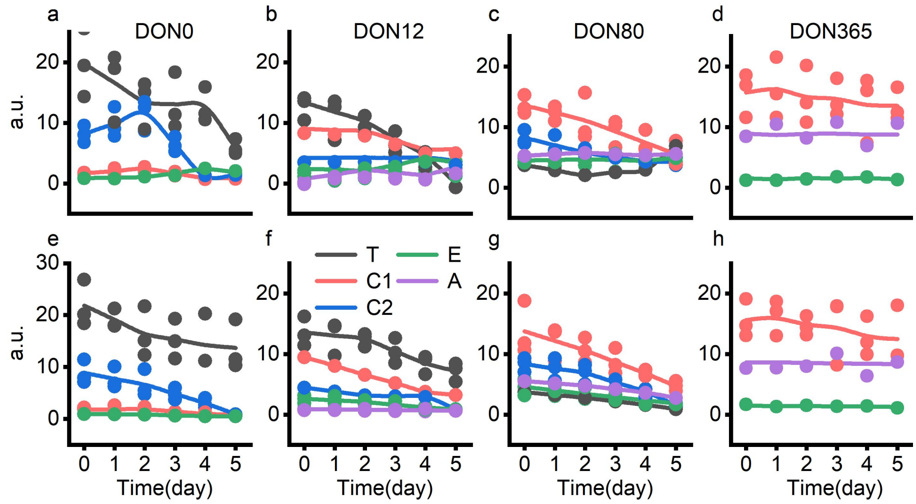

Fig .S10. Uptake dynamics of different DON components by diatoms and dinoflagellates across culture time under varying DON aging stages

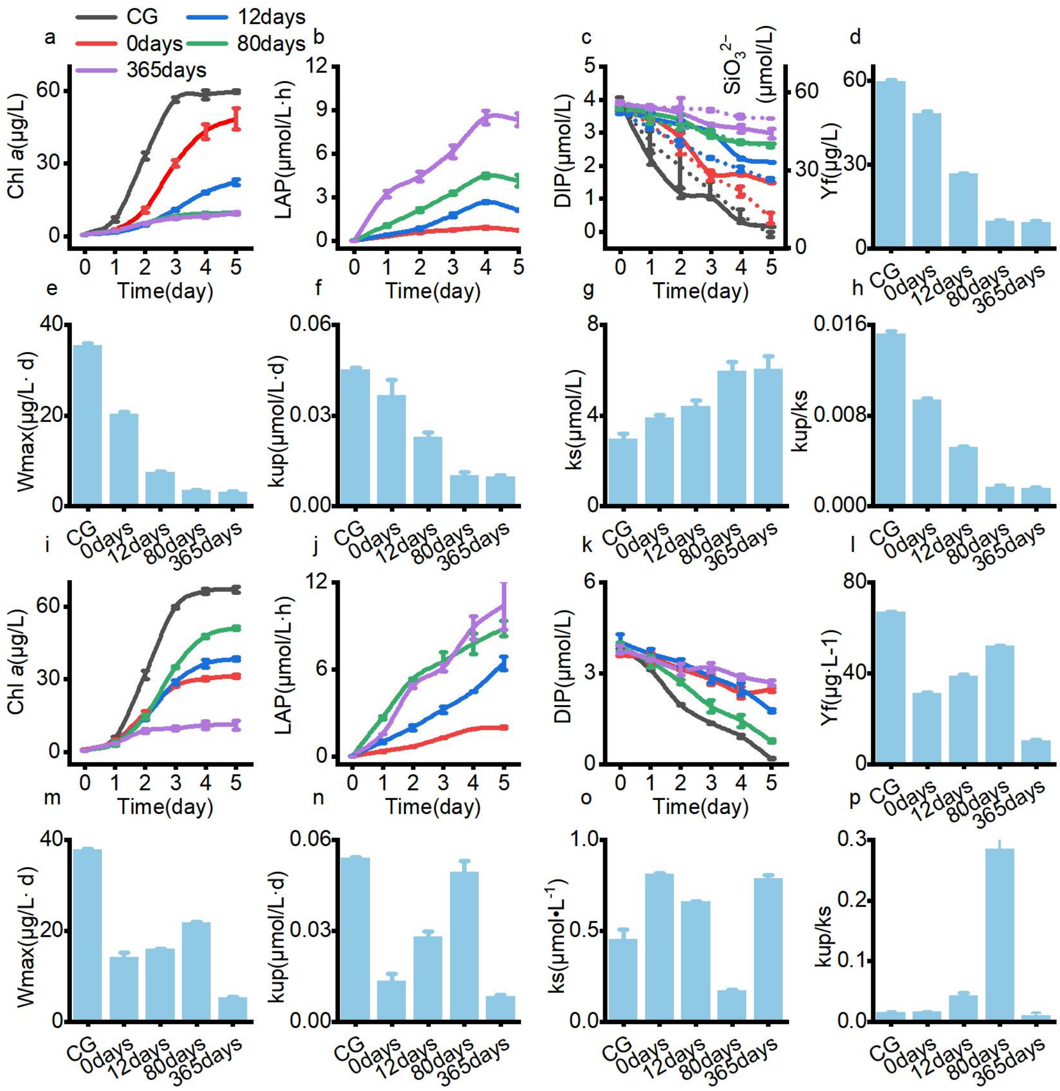

Fig .S11. Differences in growth responses during DON aging process (*C. curvisetus*: a~h; *P. minimum*:i~p)

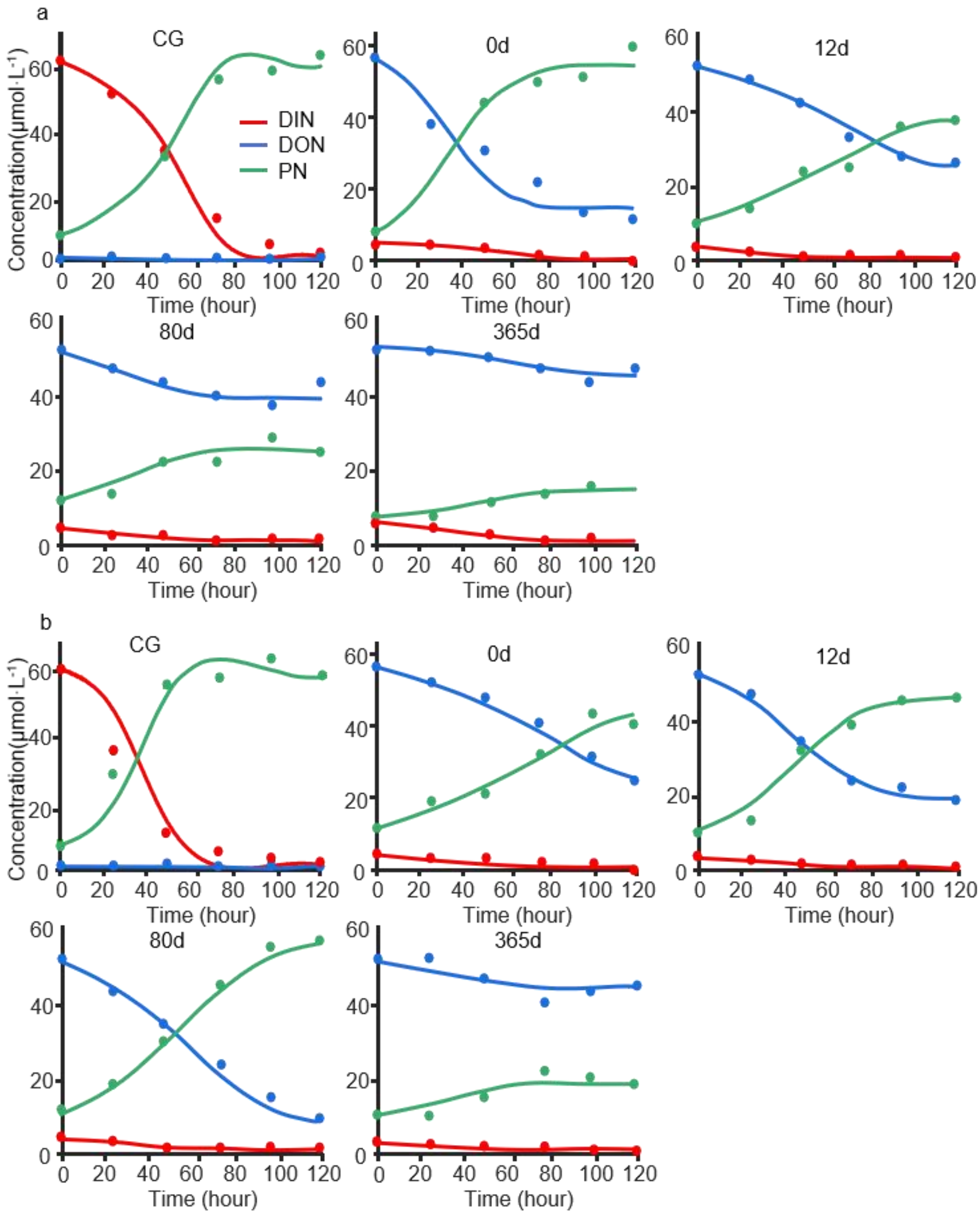

Fig .S12. Nitrogen uptake kinetics of diatoms (a) and dinoflagellates (b)

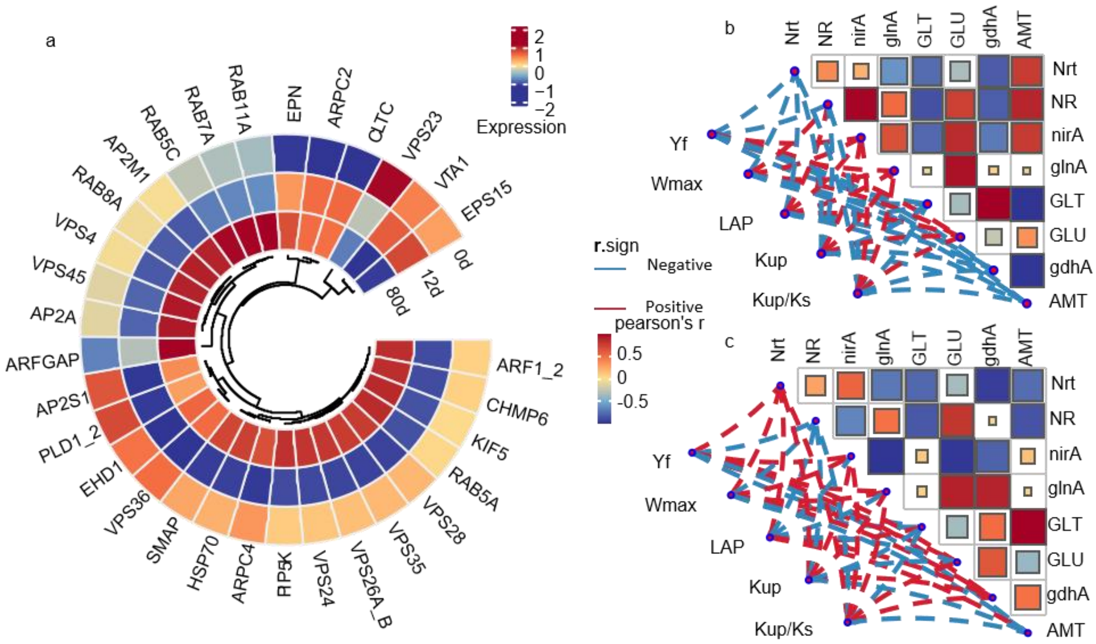

Fig. 13. Expression patterns of endocytosis-related genes across different DON aging stages (a) and their correlations with traits (b–c).