Supplementary Material

1 Supplementary Texts

Text S1. Measurements of nutrients

All samples for measurement of nutrient concentrations were gravity filtered through a sterile Sartobran® cartridge and collected in 60 mL high-density polyethylene (HDPE) bottles.

Samples for nitrate (NO_3^-) and nitrite (NO_2^-) analysis were acidified with Ultrapure HCl (Merck, 0.2%) to pH 1.7 and frozen at -20 °C until analysis. NO_3^- concentrations, suspected to be very low, were determined by a nanomolar technique using a liquid waveguide capillary flow cell (LWCC, 2.5 m fiber length). Samples were defrosted 24 h before analysis in the dark at room temperature. Since there is no method to determine NO_3^- concentrations in solution, a portion of the sample was first reduced to NO_2^- with a cadmium-copper reducing column (Aminot and Kérouel, 2004). NO_3^- concentrations were finally corrected with those of NO_2^-. The detection limits (0.9 nM) were determined by repeated measurements of analytical blanks. Since the NO_3^- concentrations of some samples were too high to be analyzed with the LWCC method without dilution, they were also analyzed with an autoanalyzer (SEAL Autoanalyzer 3 HR®, see below).

Samples for dissolved inorganic phosphate (DIP) and silicate ($Si(OH)_4$) stored at -20 °C pending analysis. Measurements for DIP and $Si(OH)_4$ as well as highly concentrated NO_3^- samples were performed with a SEAL Analytical AA3 HR autoanalyzer driven by AACE software following Aminot and Kérouel (2004).

Text S2. Measurements of particulate and dissolved trace metals in the water column

Seawater samples were collected according to the GEOTRACES guidelines (http://www.geotraces.org/images/Cookbook.pdf) from depth profiles using 24 GO-FLO bottles (12 L) with a Teflon inner coating. Bottles were mounted on a Trace Metal clean Rosette (TMR, General Oceanics Inc., Model 1018 Intelligent Rosette) attached to a 6 mm Kevlar® line. Sample bottles and equipment cleaning protocols also followed the GEOTRACES cookbook. Upon recovery of the TMR on board, the entire rosette was transferred inside a trace-metal clean ISO-7 container equipped with a class 100 laminar flow hood. The bottles were inverted three times to avoid particle sedimentation and pressurized to < 8 psi with 0.2 µm filtered dinitrogen (N_2, Air Liquide®).

Particulate trace metals. Samples for particulate trace metals were collected on acid-cleaned 0.45 µm pore-size polyethersulfone filters (Supor®, 25 mm) mounted on Swinnex® filter holders, following Planquette and Sherrell (2012). Samples were then stored frozen at -20 °C until digestion and analysis.

Total particle digestion was performed in a clean-room according to Planquette and Sherrell (2012). Particulate trace metal measurements were performed by an Element XR™ high-resolution sector field inductively coupled plasma mass spectrometry (HR-SF-ICP-MS) instrument (Thermo Fisher, Bremen, Germany) at the Pôle Spectrométrie Océan (IFREMER, France). The method employed was similar to that of Planquette and Sherrell (2012).

Dissolved trace metals. Right after collection, seawater samples were acidified to ~ pH 1.7 with 2‰ (v/v) hydrochloric acid (HCl, Ultrapure® Merck) under a class 100 laminar flow hood, double-bagged, and stored at ambient temperature in the dark before shore-based analysis.

Dissolved trace metal measurements (except dissolved iron) were carried out within 12 months of collection by an Element XR™ HR-SF-ICP-MS instrument (Thermo Fisher, Bremen, Germany), at Pôle Spectrométrie Océan (IFREMER, France). The spectrometer was coupled to an ESI seaFAST-pico™ introduction system and ran with a method analytically similar to that of Lagerström et al. (2013).

Dissolved iron samples were conditioned and analyzed by flow injection and chemiluminescence detection as described in Tilliette et al. (2022).

Text S3. Measurements of pH on the total scale

Samples of 300 mL were collected in glass bottles by completely overflowing the seawater and analyzed within 2 h of collection. The pH on the total scale (pH_T) was measured with an Agilent® Cary60 UV-Vis spectrophotometer. Seawater was transferred to 30 mL quartz cells to measure absorbances at 434 and 578 nm, before and after addition of 50 µL of meta-Cresol purple (Dickson et al., 2007). pH_T was then determined from the absorbance values according to the method described by Liu et al. (2011). The accuracy of pH_T measurements was estimated using a TRIS buffer solution of salinity 35 provided by Andrew Dickson (Scripps Institution of Oceanography, USA). Temperature at the time of measurement was determined using a Traceable® digital thermometer to adjust pH_T to the experimental temperature (25-26 °C).

Text S4. Measurements of total alkalinity

Samples of 500 mL were poisoned a few minutes after collection with 100 µL of mercury(II) chloride ($HgCl_2$; 0.02%). Total alkalinity (A_T) was measured using a Metrohm® Titrando 888 titrator and a calibrated Methrom® Ecotrode Plus glass electrode using **(1)** NBS buffers (pH 4.0 and 7.0 to ensure a Nernstian slope) and then **(2)** TRIS buffer solution of salinity 35, provided by Andrew Dickson (Scripps Institution of Oceanography, USA). Triplicate titrations were performed on 50 mL subsamples at 25 °C, and A_T was measured as described by Dickson et al. (2007). Titrations of certified material provided by Andrew Dickson (Scripps Institution of Oceanography, USA) returned a A_T value of 2209.374 ± 3.212 µmol kg^{-1} (n = 21), consistent with the nominal value of 2212 µmol kg^{-1} (batch #186).

Text S5. Determination of the particulate trace metal fraction recovered in traps

To determine the portion of a trace metal (TM) recovered in traps based on the amount of particulate TM (pTM) added by fluids, the pTM stocks (in nmol) of minicosms and traps were determined. Stock of a pTM in each minicosm was calculated from the added volumes of each end-member (i.e., fluid or surface) and their pTM concentration as follows:

$$Stock_{minicosm} = \left(pTM_{surf} * V_{surf}\right) + \left(pTM_{fluid} * V_{fluid}\right) \quad (1)$$

pTM_{surf} and pTM_{fluid} refer to the pTM concentration (nmol L^{-1}) in the surface and fluid end-members, respectively. V_{surf} and V_{fluid} refer to the added volume (L) of surface and fluid end-members, respectively, in each minicosm (see *Table 1*).

Stock of pTM in traps was estimated using the molecular weight and the pTM amount recovered in traps according to the formula:

$$Stock_{trap} = \frac{pTM_{trap}}{molecular\ weight} \quad (2)$$

pTM_{traps} refers to the pTM amount (g g^{-1}) collected in traps. Molecular weight of each pTM is in g mol^{-1}.

Finally, the percentage of pTM recovered in traps relative to the pTM concentration initially added after mixing could be determined from these stocks as follows:

$$\%\ of\ recovery = \frac{pTM\ stock_{trap} * 100}{pTM\ stock_{minicosm}} \quad (3)$$

Text S6. Determination of the percentage of Fe uptake in minicosms

To determine the proportion of consumed DFe relative to the total DFe stock contained in each minicosm, the total and consumed Fe stocks were determined in each minicosm and for each sampling time. The total DFe stock in each minicosm was determined using the DFe concentrations (nmol L^{-1}) and the volume remaining in each minicosm (L) according to the formula:

$$DFe\ stock\ (nmol) = [DFe] * V_{minicosm} \quad (4)$$

The consumed DFe was determined using the sampling time (days), the volume remaining in each minicosm (L) and the Fe uptake rate (pmol L^{-1} d^{-1}) according to the formula:

$$Consumed\ DFe\ stock\ (nmol) = \frac{sampling\ time * V_{minicosm} * uptake\ rate}{1000} \quad (5)$$

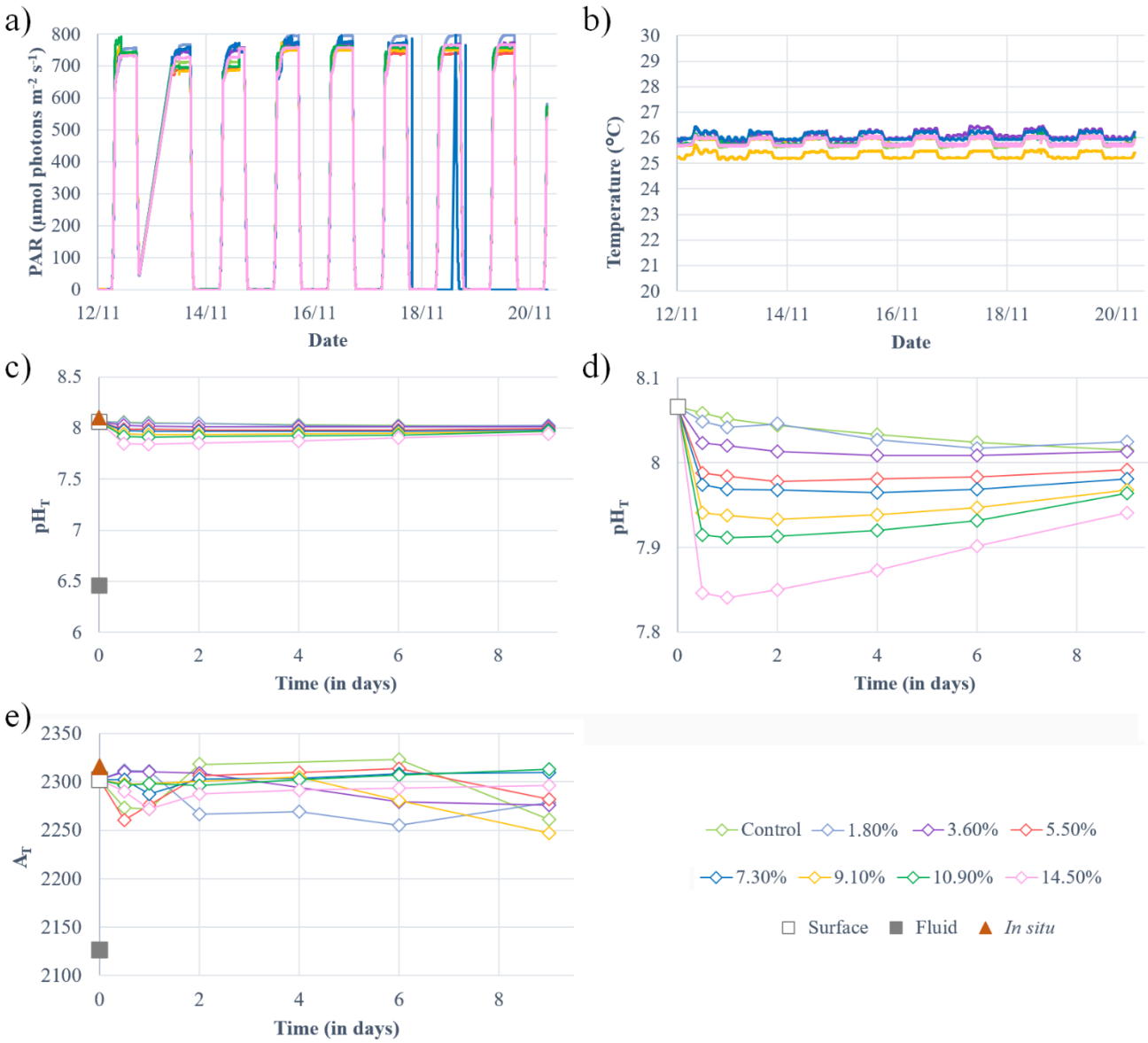
Fe uptake rates were measured by Lory et al. (2022) during the cruise at stations influenced and non-influenced by hydrothermal inputs which allowed for discrimination of uptake rates of fluid-subjected communities from control communities. Uptake rates were also determined according to the different size classes of phytoplankton (i.e., pico, nano and microphytoplankton).

Finally, the percentage of consumed DFe could be determined at each sampling time using the following formula:

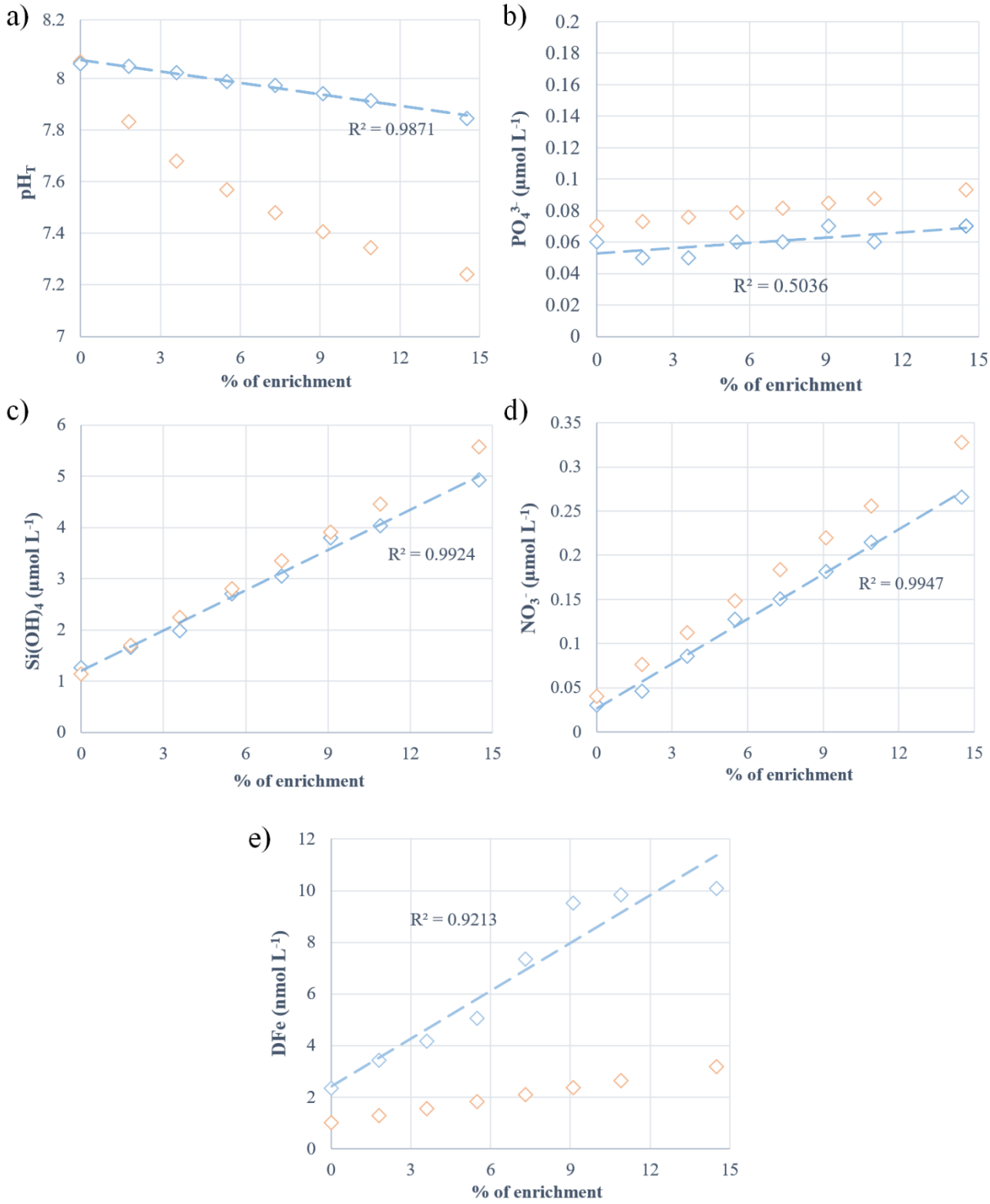
$$\%\ consumed\ DFe = 100 - \frac{100 * (DFe\ stock - consumed\ DFe\ stock)}{DFe\ stock} \quad (6)$$

2 Supplementary Figures and Tables

2.1 Supplementary Figures

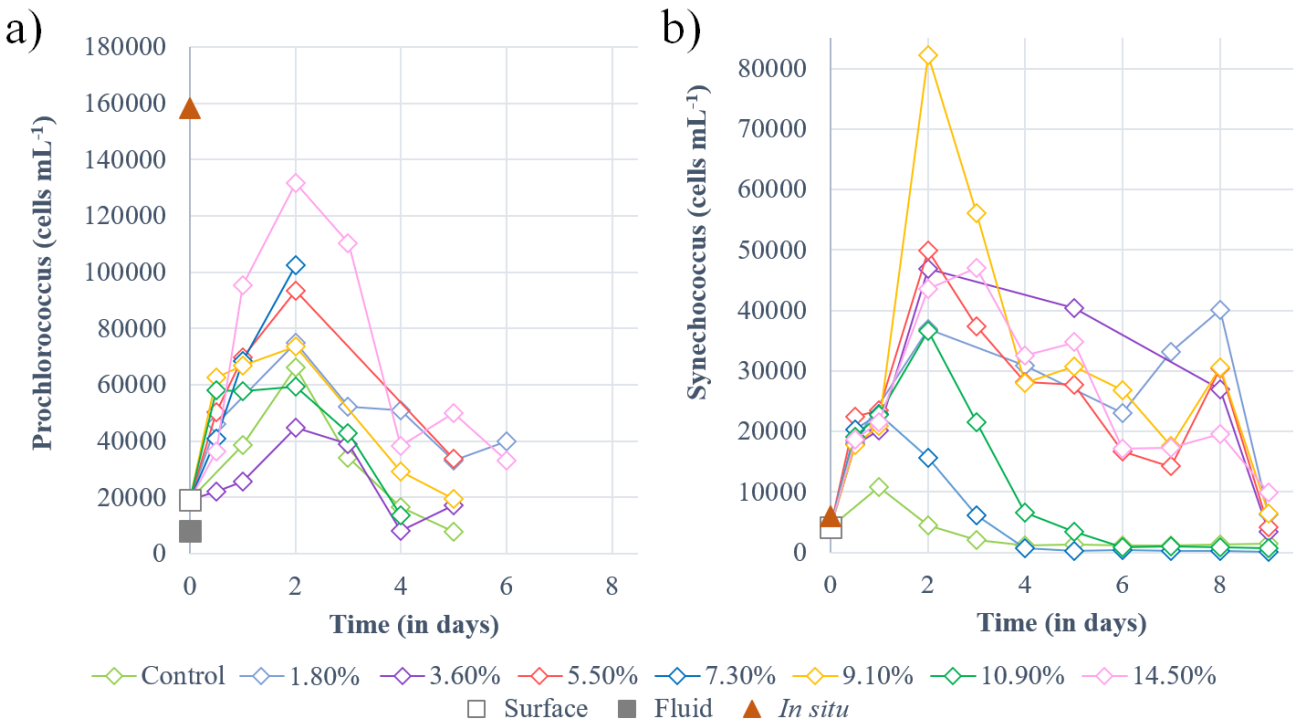


Supplementary Figure S1. Experimental conditions during the nine-day experiment. (a) Photosynthetically active radiation (PAR; µmol photons m^{-2} s^{-1}), **(b)** temperature (°C), **(c, d)** pH on the total scale (pH_T) with different scales and **(e)** total alkalinity (A_T) data in the eight minicosms during the experiment. Temperature and PAR were measured continuously. A_T and pH_T were measured discretely over the six sampling times defined for the experiment. Values measured for A_T and pH_T in the surface and fluid end-members are represented by an empty and a solid gray square, respectively. The red triangle represents the value measured *in-situ* above the sampled hydrothermal source at 5 m during the CTD casts of TONGA cruise.

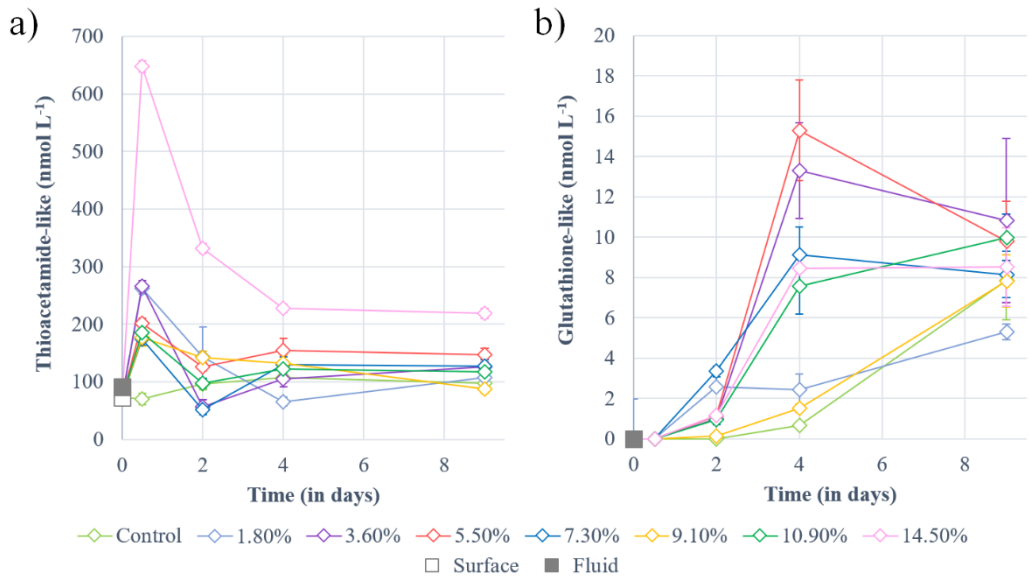


Supplementary Figure S2. Dilution curves of the mixing performed in the minicosms. To verify the accuracy of the mixing performed, theoretical dilution curves (orange dots) were calculated for

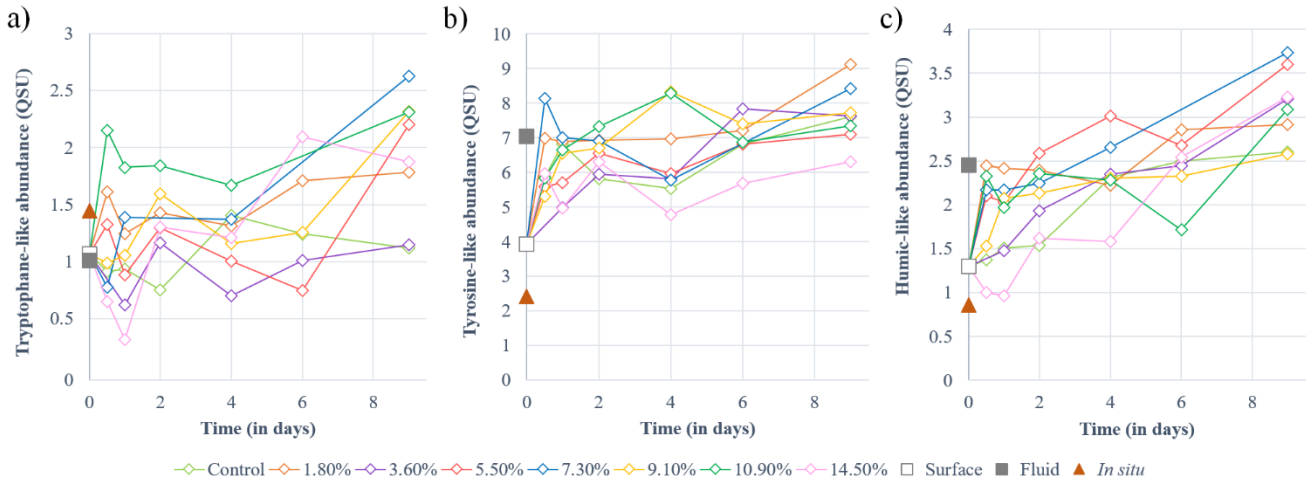
several parameters using the measured value of the surface and fluid end-members. These curves were then compared to experimental values measured at day 0.5 (12 h). The parameters included are **(a)** pH on the total scale (pH_T), **(b)** dissolved inorganic phosphate (PO_4^{3-}, µmol L^{-1}), **(c)** silicate ($Si(OH)_4$, nmol L^{-1}), **(d)** nitrate (NO_3^-, µmol L^{-1}) and **(e)** dissolved iron (DFe, nmol L^{-1}). The coefficient (R^2) and regression line are displayed for each parameter (blue line). Note that the measured dilution curves were obtained 12 hours after mixing and that some chemical (precipitation, degassing, …) and/or biological (consumption, remineralization, …) processes may have occurred in the meantime.



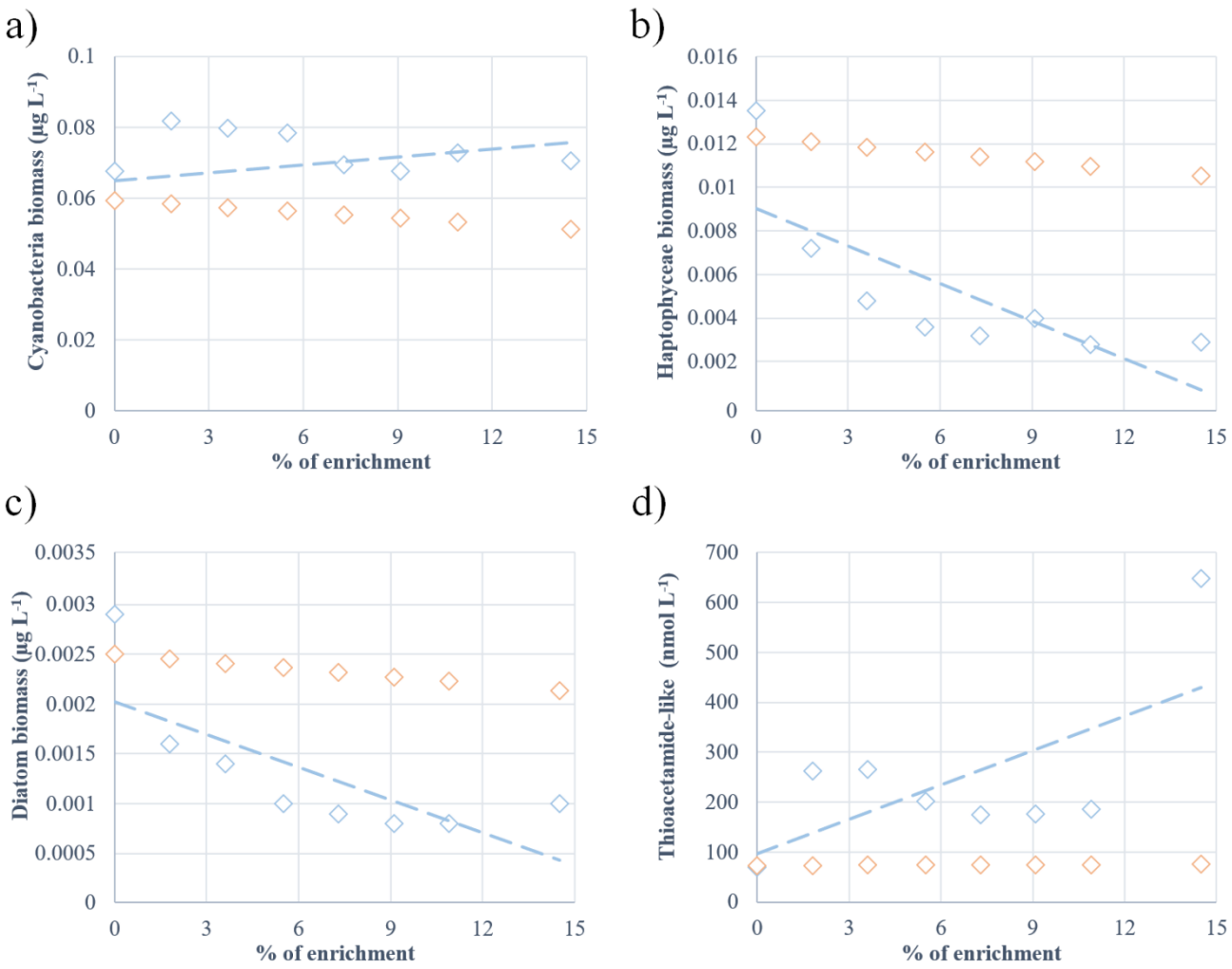
Supplementary Figure S3. Dynamics of non-diazotrophic cyanobacteria during the nine-day experiment measured by flow cytometry. Abundance of **(a)** *Prochlorococcus* (cells mL^{-1}) and **(b)** *Synechococcus* (cells mL^{-1}).



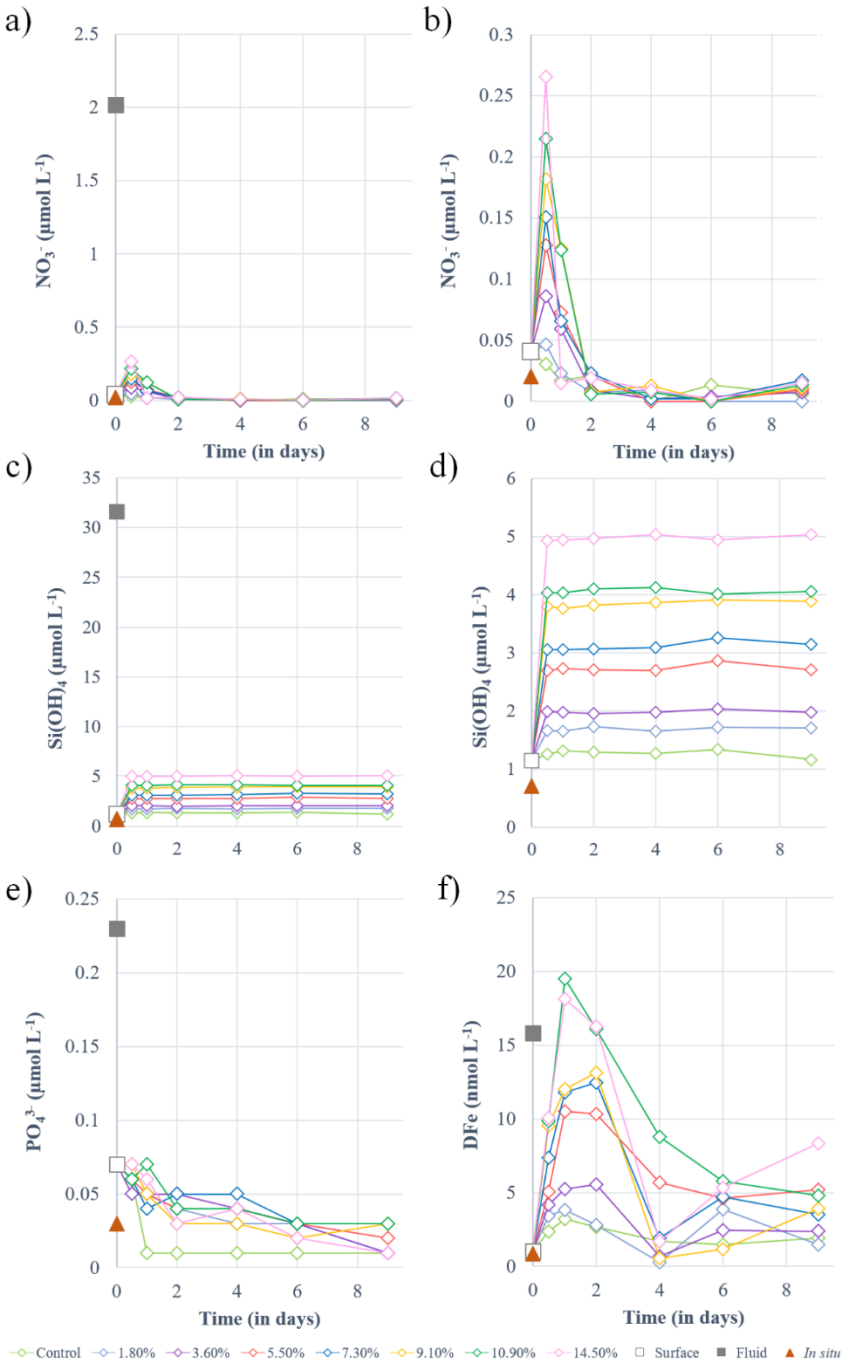
Supplementary Figure S4. Dynamics of thiol compounds during the nine-day experiment. Concentrations of thioacetamide-like (TA) **(a)** and glutathione-like (GSH) **(b)** thiol compounds in nmol L^{-1}.



Supplementary Figure S5. Dynamics of fluorescent dissolved organic matter during the nine-day experiment. Fluorescence intensities of tryptophan-like **(a)**, tyrosine-like **(b)** and humic-like **(c)** fluorophores in quinine sulfate unit (QSU).



Supplementary Figure S6. Dilution curves of the mixing performed in the minicosms. To ensure that the phytoplankton biomass and thiol dynamics observed in the fluid-enriched minicosms were not solely due to the dilution effect during the mixing between fluid and surface end-members, theoretical dilution curves were calculated (orange) using values measured in both end-members. These curves were compared to the values measured after 12 h of mixing in the different fluid treatments (blue; from +0% to +14.5%). The parameters included are the biomass of **(a)** cyanobacteria, **(b)** haptophyceae and **(c)** diatoms in µg L^{-1} as well as the concentrations of thioacetamide-like compounds (i.e., thiols) in nmol L^{-1}. It can be noted that none of the parameters measured after 12 h (blue) correlates with the theoretical values deduced from the dilution process (orange). Thus, biological and/or chemical processes must have acted on these parameters to lead to the dynamics observed 12 h after the mixing of the two end-members.



Supplementary Figure S7. Macronutrient and dissolved iron (DFe) dynamics during the nine-day experiment. Concentrations of **(a, b)** nitrate (NO_3^-), **(c, d)** silicate ($Si(OH)_4$), **(d)** dissolved inorganic phosphate (PO_4^{3-}), and **(e)** dissolved iron (DFe) in the eight minicosms during the experiment. All concentrations are shown in µmol L^{-1}, except for DFe concentrations shown in nmol L^{-1}.

2.2 Supplementary Tables

Table S1. **Sampling protocol followed for the experiment**

Parameters	***Sampling time***										
	End-member -	Day 0.5 12 h	Day 1 24 h	Day 2 48 h	Day 3 72 h	Day 4 96 h	Day 5 120 h	Day 6 144 h	Day 7 168 h	Day 8 192 h	Day 9 216 h
Photosynthetic pigments concentrations	✕	✕	✕	✕		✕		✕			✕
Synechococcus and *Prochlorococcus* abundance	✕	✕	✕	✕	✕	✕	✕	✕	✕	✕	✕
^{13}C-net community production	✕	✕	✕	✕		✕		✕			✕
N_2 fixation	✕	✕		✕		✕		✕			✕
Thiols compounds	✕	✕		✕		✕					✕
Fluorescent dissolved organic matter	✕	✕	✕	✕		✕		✕			✕
Nutrients (NO_3^-, PO_4^{3-}, $Si(OH)_4$)	✕	✕	✕	✕		✕		✕			✕
Dissolved iron	✕	✕	✕	✕		✕		✕			✕
pH on the total scale	✕	✕	✕	✕		✕		✕			✕
Total alkalinity	✕	✕	✕	✕		✕		✕			✕

Table S2. **Particulate (p) and dissolved (d) trace metal concentrations in the fluid and surface end-members.**

	pCd	pCu	pPb	THg	pFe	dFe	pAl
Fluid end-member	4.84	494	24.6	10	224	15.81	24.8
Surface end-member	0.42	7.55	0.27	0.95	0.29	1.08	0.9
Enrichment ratio	11.5	65.5	91.6	10.5	768.6	14.6	27.5

Note. Concentrations of most trace metals are shown in pmol L^{-1}, except for Al and Fe reported in nmol L^{-1}. The enrichment ratio illustrates the enrichment of an element in the fluid end-member relative to the surface end-member. Cd = cadmium, Cu = copper, Pb = lead, THg = total mercury, Fe = iron and Al = aluminum.