

**Supplementary Information to:**

Hypoxia-tolerant zooplankton may reduce biological carbon pump efficiency in the Humboldt current system off Peru

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Supplementary Table 1: Sediment trap deployment (D) and recovery (R) locations, dates, collection times and depths.

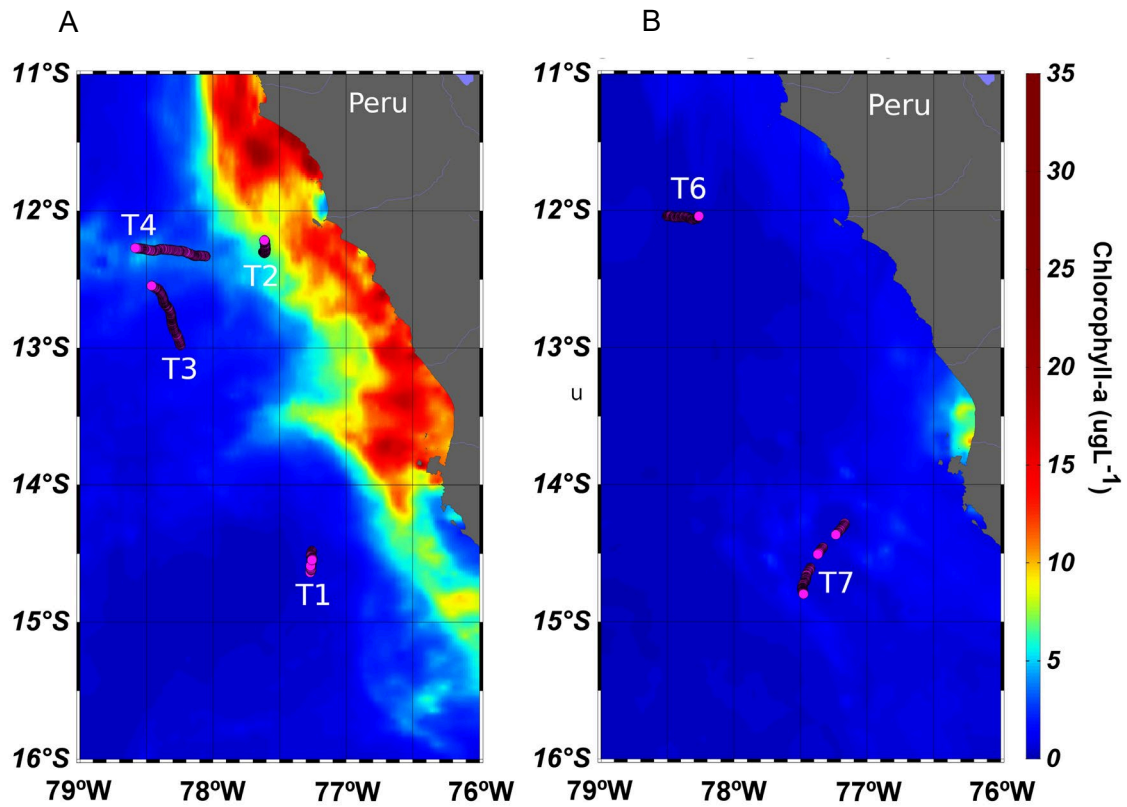
| Trap | D-<br>location      | R-<br>location      | D/R-time<br>(DD/MM) | Bottom depth<br>(D/R; m) | Duration<br>(days) | Trap depths<br>(m)                          |
|------|---------------------|---------------------|---------------------|--------------------------|--------------------|---------------------------------------------|
| 1    | 14.48 S,<br>77.25W  | 14.55 S,<br>77.25 W | 14/04.-<br>17/04    | 5500/ 5000               | 2.9                | 50, 100, 150,<br>200, 300, 400,<br>500, 600 |
| 2    | 12.29 S,<br>77.62 W | 12.22 S,<br>77.61 W | 20/04 -<br>24/04    | 500/ 470                 | 5.0                | 40, 100, 150,<br>200, 300                   |
| 3    | 12.98 S,<br>78.24 W | 12.54 S,<br>78.45 W | 22/04-<br>28/04     | 5000/ 4000               | 6.0                | 50, 70, 100, 200,<br>300, 400, 500,<br>600  |
| 4    | 12.33 S,<br>78.05 W | 12.27 S,<br>78.58 W | 26/04-<br>30/04     | 2000/ 3500               | 4.0                | 50, 100, 150,<br>200, 300, 400,<br>500, 600 |
| 6    | 12.04 S,<br>77.71 W | 12.04 S,<br>78.26 W | 08/06-<br>13/06     | 3060/ 2170               | 4.9                | 60, 100, 150,<br>200, 300, 400,<br>500, 600 |
| 7    | 14.29 S,<br>77.17 W | 14.49 S,<br>77.53 W | 17/06-<br>23/06     | 4700/ 4160               | 5.9                | 60, 100, 150,<br>200, 300, 400,<br>500, 600 |

Supplementary Table 2: Statistics of *Martin*-type power law function applied to fit export fluxes ( $F$ , mg C m<sup>-2</sup> d<sup>-1</sup>) over depth using the shallowest trap depth ( $z_0$ ) or 100m as reference depth. MLD: Mixed layer depth of deployment/ recovery sites were calculated<sup>55</sup> as depth where  $\delta_0 = \delta_{10m} + 0.03$  kg m<sup>-3</sup>, EZ<sub>base</sub>: base of the euphotic zone taken from Karthäuser et al. (2021)<sup>56</sup>, N= number of distinct samples.

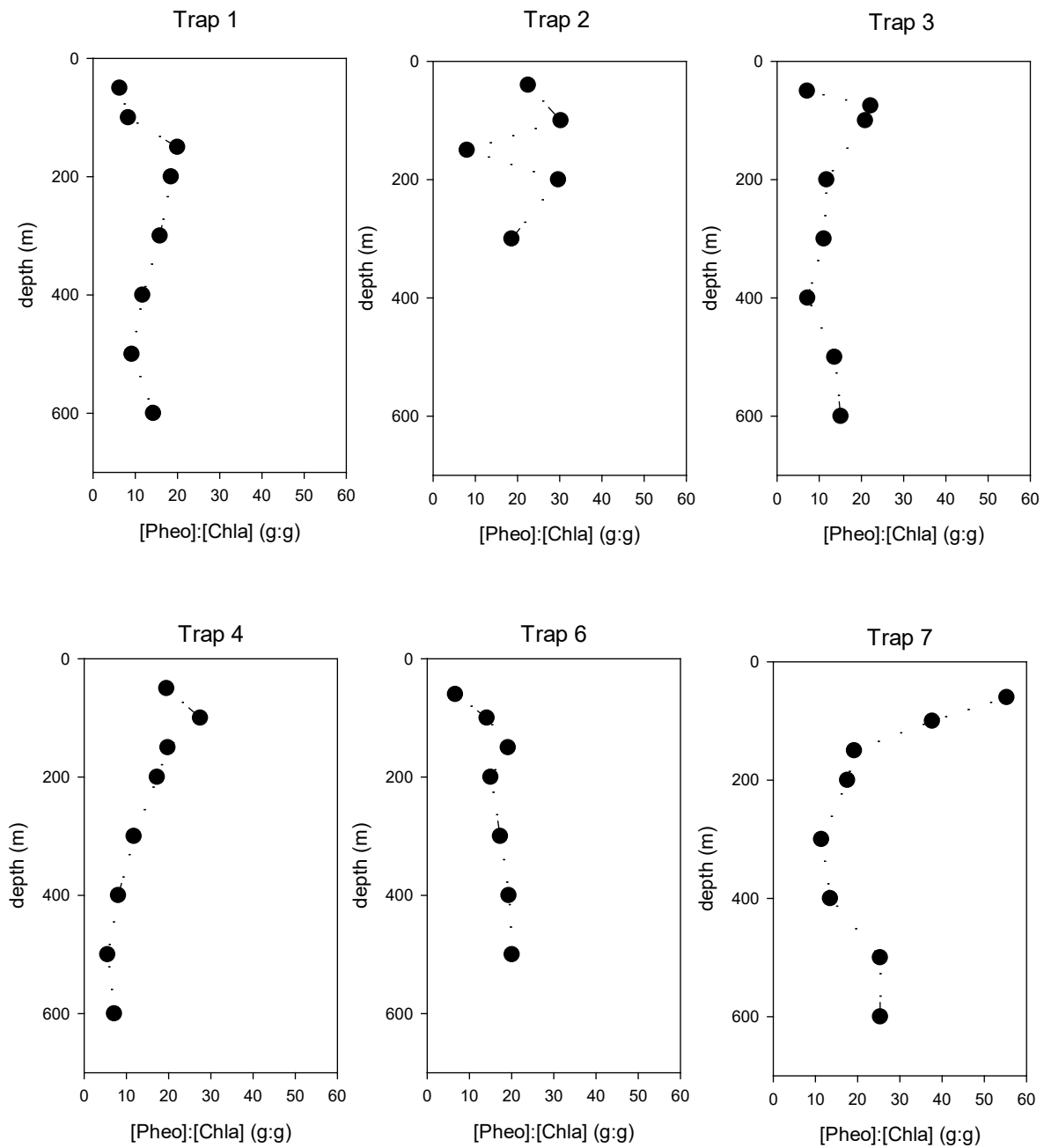
| Trap | MLD<br>(m) | EZ <sub>base</sub><br>(m) | $F_{z0}$ | $b$<br>( $z_0$ ) | SE   | r <sup>2</sup> | F <sub>100</sub> | $b$<br>( $z100$ ) | SE   | r <sup>2</sup> | N |
|------|------------|---------------------------|----------|------------------|------|----------------|------------------|-------------------|------|----------------|---|
| 1    | 24/25      | 47                        | 134      | 0.71             | 0.02 | 0.98           | 70               | 0.59              | 0.02 | 0.90           | 8 |
| 2    | 11/12      | 31                        | 541      | 0.62             | 0.05 | 0.88           | 412              | 1.07              | 0.04 | 0.94           | 5 |
| 3    | 32/21      | 48                        | 163      | 0.95             | 0.03 | 0.88           | 135              | 1.46              | 0.02 | 0.97           | 8 |
| 4    | 16/20      | 44                        | 228      | 0.33             | 0.01 | 0.97           | 166              | 0.29              | 0.01 | 0.90           | 8 |
| 6    | 40/24      | 25                        | 88       | 0.90             | 0.01 | 0.99           | 51               | 0.78              | 0.01 | 0.94           | 8 |
| 7    | 35/22      | 39                        | 345      | 1.04             | 0.01 | 0.98           | 206              | 1.18              | 0.01 | 0.98           | 8 |

Supplementary Table 3: Flux attenuation coefficients (*Martin-b*), calculated with z100 as reference depth, median temperature and oxygen concentrations from sediment trap studies conducted at different oceanic sites. Refs. 1) Marsay et al. (2015)<sup>29</sup>, 2) Van Mooy et al. (2002)<sup>31</sup>, 3) Engel et al. (2017)<sup>48</sup> 4) Hartnett et al. (1998)<sup>57</sup>, 5) Martin et al. (1987)<sup>5</sup>.

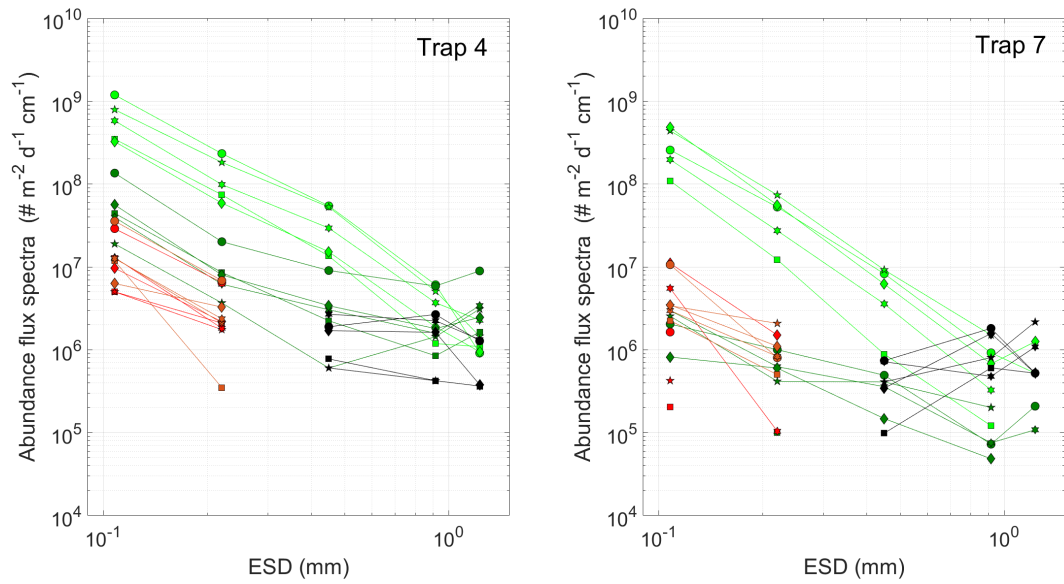
| Station            | Latitude<br>(°N) | Longitude<br>(°W) | Attenuation<br>coefficient<br>( <i>Martin-b</i> ) | T<br>(°C) | O <sub>2</sub><br>(μmol L <sup>-1</sup> ) | Refs. |
|--------------------|------------------|-------------------|---------------------------------------------------|-----------|-------------------------------------------|-------|
| K2-1               | 47               | -161              | 0.57                                              | 3.5       | 85                                        | 1     |
| K2-2               | 47               | -161.5            | 0.49                                              | 3.5       | 85                                        | 1     |
| ALOHA-1            | 23               | -157.5            | 1.25                                              | 16.5      | 207                                       | 1     |
| ALOHA-2            | 22.5             | -158.5            | 1.36                                              | 16        | 207                                       | 1     |
| PAP                | 49               | -16.5             | 0.7                                               | 11.5      | 250                                       | 1     |
| Iceland            | 63               | -24               | 0.69                                              | 8         | 280                                       | 1     |
| Irminger           | 61               | -32               | 0.88                                              | 6.5       | 285                                       | 1     |
| NASG               | 27               | -31               | 1.59                                              | 17.5      | 205                                       | 2     |
| Mexico_OMZ         | 22.5             | -106.4            | 0.4                                               | 11.5      | 5                                         | 2     |
| ETNA_OMZ           | 10               | -21               | 0.74                                              | 12        | 70                                        | 3     |
| ETNA_OMZ           | 10.5             | -21               | 0.86                                              | 12        | 70                                        | 3     |
| Mexico_OMZ         | 46.5             | -124.5            | 0.36                                              | 11.5      | 5                                         | 4.2   |
| Contin.marg. (WAS) | 22.5             | -106.5            | 0.93                                              | 6.5       | 70                                        | 4.2   |
| Prevtx             | 37               | -123              | 0.86                                              | 7.5       | 110                                       | 5     |
| ETSP-VERTEX        | 12.25            | -75.9             | 0.32                                              | 12        | 10                                        | 5     |
| 1                  | 36.1             | -122.6            | 0.83                                              | 8         | 95                                        | 5     |
| 2                  | 35               | -128.2            | 0.88                                              | 8.5       | 155                                       | 5     |
| 4                  | 33.3             | -139.2            | 0.97                                              | 12.5      | 215                                       | 5     |
| 5                  | 28               | -155              | 0.97                                              | 14.5      | 215                                       | 5     |
| II                 | 18               | -108              | 0.81                                              | 11.5      | 7                                         | 5     |
| III                | 15.7             | -107.5            | 0.65                                              | 12        | 7                                         | 5     |
| NPEC               | 14               | -130              | 0.86                                              | 11        | 15                                        | 5     |



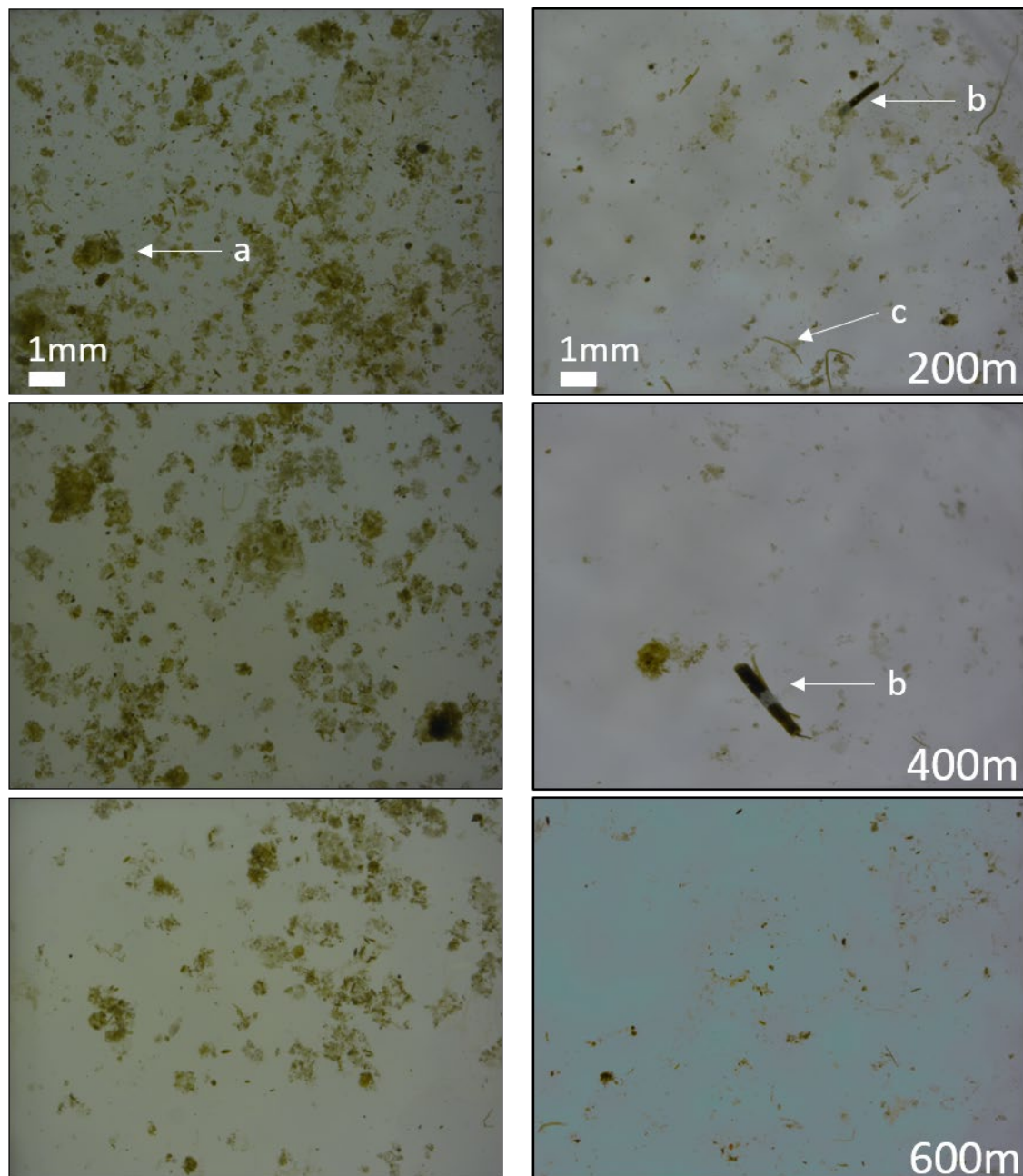
Supplementary Figure 1: Trajectories of the six surface-tethered sediment trap arrays deployed in the ETSP-OMZ. The colorbar indicates level-3 MODIS monthly average surface chlorophyll a ( $\mu\text{g L}^{-1}$ ) concentration for (A) April T1, T2, T3 and T4 and, (B) June T6 and T7. Data plotted using ODV<sup>58</sup>.



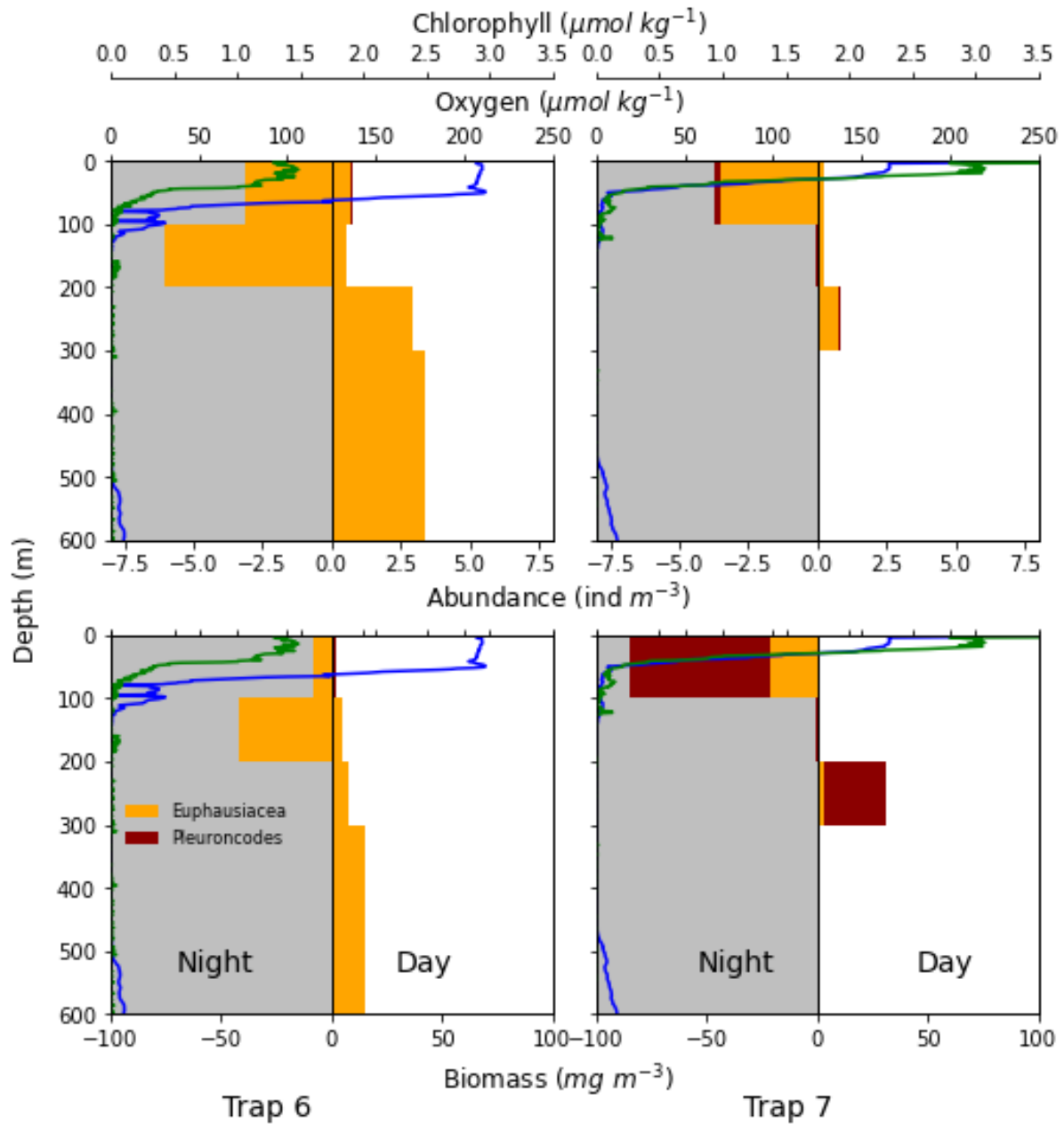
Supplementary Figure 2: Ratio of pheopigments (sum of pheophorbide and pyropheophorbide) and Chlorophyll *a*, [Pheo]:[Chla], in sediment traps at different depths during the deployments off Peru. A decrease of [Pheo]:[Chla] in deeper traps may point to an increasing amount of larger cells over depth, as larger cells have a higher Chla content<sup>59</sup> and typically higher sinking velocity.



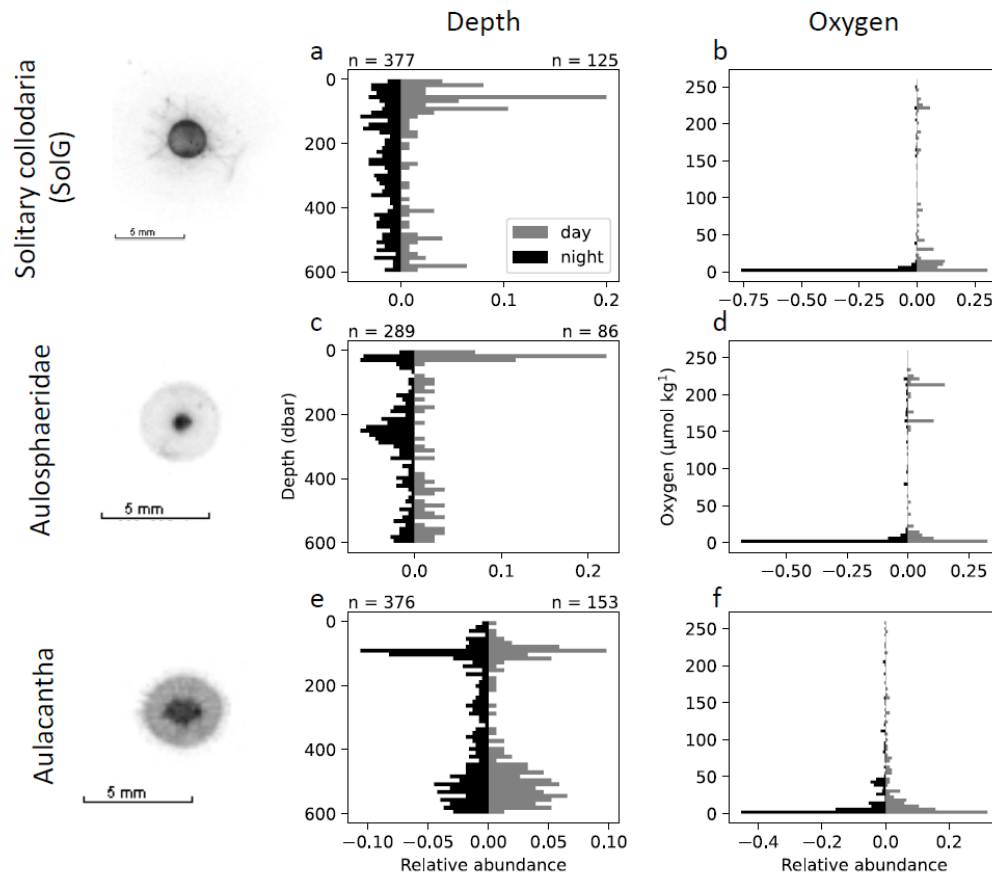
Supplementary Figure 3: Abundance flux spectra of various types of particles in trap deployments T4 and T7. All particles have been binned in five size classes (in equivalent sphere diameter, 0.071-0.145, 0.145-0.296, 0.296-0.603, 0.603-1.228, >1.228 mm). Symbols, green: phytoplankton aggregates, dark green: fecal aggregates, black: cylindrical fecal pellets, red: oval fecal pellets, orange: spherical fecal pellets. Samples from 200m are represented using circles, 300m squares, 400m pentagram stars, 500m hectogram stars and diamonds represent samples from 600m depth.



Supplementary Figure 4: Pictures of intact particles collected with gel traps at 200, 400 and 600m in trap 4 (T4) and trap 7 (T7). Scale bar: 1 mm (a) phytoplankton aggregate, (b) squat lobster (*Pleuroncodes monodon*) fecal pellet, and (c) euphausiid fecal pellet.



Supplementary Figure 5: Vertical multinet-based abundance (top panels) and biomass distribution (bottom panels) in the upper 600m of the squat lobsters and euphausiids at the site of trap 6 (left) and trap 7 (right) during the night (shaded area) and day (white area) with corresponding oxygen (blue line) and chlorophyll-*a* (green line) profiles.



Supplementary Figure 6: Relative frequency distribution of solitary globular collodaria (SolG, top row), Aulosphaeridae (middle row), and Aulacantha (bottom row) in relation to depth (a,c,e) and oxygen distribution (b,d,f) during the day (grey bars) and night (black bars) based upon *in situ* images collected with an Underwater Vision Profiler (UVP5). Scale bar always 5 mm.

## Supplementary References

<sup>55</sup>de Boyer Montégut, C., G. Madec, A. S. Fischer, A. Lazar, and D. Iudicone. Mixed layer depth over the global ocean: an examination of profile data and a profile-based climatology. *J. Geophys. Res.*, **109**, C12003 (2004). doi:10.1029/2004JC002378

<sup>56</sup>Karthäuser, C., Ahmerkamp, S., Marchant, H. K., Bristow, L. A., Hauss, H., Iversen, M. H. & Kuypers, M. M. Small sinking particles control anammox rates in the Peruvian oxygen minimum zone. *Nature comm.*, **12** (1), 1-12 (2021).

<sup>57</sup>Hartnett, H.E., Keil, R. G., Hedges, J.I. & Devol, A.H. Influence of oxygen exposure time on organic carbon preservation in continental margin sediments. *Nature*, **391**, 672-674 (1998).

<sup>58</sup>Schlitzer, R. Ocean Data View, <http://odv.awi.de> (2013).

<sup>59</sup>Álvarez, E., Nogueira, E. & López-Urrutia, A. *In vivo* single-cell fluorescence and size scaling of phytoplankton chlorophyll content. *App. Env. Microbiol.* 83, 7, e03317-16 (2017).