****

**Supplementary Figure S1.** The diagram of potential temperature-salinity for coastal stations in spring 2017 (A) and summer 2018 (B). The red points in panels A and B represent the end-members of the CDW (Changjiang Diluted Water), the TSW (Taiwan Strait Water) and the KSSW (Kuroshio Subsurface Water).



**Supplementary Figure S2.** Vertical distributions of concentrations of particulate organic carbon (POC, mg L-1) and carbon-normalized concentrations of sterols (μg mg-1 C-1) in spring 2017 (A-D) and summer 2018 (E-H). ΣPB: the sum of brassicasterol and dinosterol.



**Supplementary Figure S3.** Vertical distributions of carbon-normalized concentrations of fatty acids (μg mg-1 C-1) in spring 2017 (A-D) and summer 2018 (E-H). TFAs: total fatty acids. SFAs: saturated fatty acids. MUFAs: monounsaturated fatty acids. PUFAs: polyunsaturated fatty acids.

**Supplementary Figure S4**. PCA biplot based on the proportions (%) of lipid biomarkers under the dominance of different water masses in the surface (A, C) and deep layer (B, D) in spring 2017 (A, B) and summer 2018 (C, D). To clearly display the relationship between water masses and biomarkers, stations dominated by different water masses are distinguished by different colors. The green triangles represent stations with CDW proportion ≥ 50%, the blue triangles represent stations with KSSW proportion ≥ 50%, the red triangles represent stations with TSW proportion ≥ 50%, and the black triangles represent stations with mixed water masses (CDW proportion < 50%, KSSW proportion < 50%, and TSW proportion < 50%). CDW: Changjiang Diluted Water; TSW: Taiwan Strait Water; KSSW: Kuroshio Subsurface Water.**Supplementary Figure S5.** The proportions of saturated fatty acids (SFAs), monounsaturated fatty acids (MUFAs) and polyunsaturated fatty acids (PUFAs) in the surface and deep layer in spring (A, B) and summer (C, D).



**Supplementary Figure S6.** The carbon-normalized concentrations of sterols (μg mg-1 C-1) (A, C) and fatty acids (μg mg-1 C-1) (B, D) in the surface and deep layer in spring 2017 (A, B) and summer 2018 (C, D).



**Supplementary Figure S7.** Vertical distributions of the concentrations of brassicasterol (ng L-1) and polyunsaturated fatty acids (PUFAs, μg L-1) in spring 2017 (A, B) and summer 2018 (C, D).



**Supplementary Figure S8.** The box plot of 22:6n-3/20:5n-3 (DHA/EPA) in the surface and deep layer in spring 2017 and summer 2018.

**Supplementary Table S1.** Station information for the cruises in spring 2017 and summer 2018.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Station | Longitude (°E) | Latitude (°N) | Depth (m) | Bottom depth (m) | Sampling volume (L) | |
| Spring-A3-8 | 123.4922 | 31.39226 | 3 | 41.2 | | 100 |
| Spring-A2-3 | 122.7536 | 31.88042 | 3 | 36.1 | | 100 |
| Spring-A3 | 123.0005 | 30.4219 | 3 | 52.4 | | 25 |
| Spring-A3 | 123.0005 | 30.4219 | 45 | 52.4 | | 25 |
| Spring-B4 | 122.9998 | 29.8599 | 3 | 55.6 | | 25 |
| Spring-B4 | 122.9998 | 29.8599 | 10 | 55.6 | | 25 |
| Spring-B4 | 122.9998 | 29.8599 | 50 | 55.6 | | 25 |
| Spring-C3 | 122.509 | 29.5002 | 3 | 29.8 | | 25 |
| Spring-C3 | 122.509 | 29.5002 | 7 | 29.8 | | 25 |
| Spring-C3 | 122.509 | 29.5002 | 25 | 29.8 | | 10 |
| Spring-D6 | 122.7502 | 28.9806 | 3 | 60.4 | | 25 |
| Spring-D6 | 122.7502 | 28.9806 | 53 | 60.4 | | 25 |
| Spring-E5 | 122.3329 | 28.4479 | 3 | 58.2 | | 25 |
| Spring-E5 | 122.3329 | 28.4479 | 6 | 58.2 | | 25 |
| Spring-E5 | 122.3329 | 28.4479 | 51 | 58.2 | | 25 |
| Spring-F2 | 121.8604 | 28.1542 | 25 | 29.8 | | 25 |
| Spring-F2 | 121.8604 | 28.1542 | 3 | 29.8 | | 10 |
| Spring-G4 | 121.5551 | 27.411 | 3 | 50 | | 25 |
| Spring-G4 | 121.5551 | 27.411 | 20 | 50 | | 25 |
| Spring-G4 | 121.5551 | 27.411 | 45 | 50 | | 25 |
| Spring-H5 | 120.9825 | 26.7373 | 3 | 59 | | 25 |
| Spring-H5 | 120.9825 | 26.7373 | 20 | 59 | | 25 |
| Spring-H5 | 120.9825 | 26.7373 | 54 | 59 | | 25 |
| Summer-A2-4 | 123.1055 | 31.87937 | 3 | 37.6 | | 25 |
| Summer-A2-4 | 123.1055 | 31.87937 | 12 | 37.6 | | 25 |
| Summer-A2-4 | 123.1055 | 31.87937 | 35 | 37.6 | | 25 |
| Summer-A4-5 | 123.0283 | 31.16658 | 3 | 60.7 | | 25 |
| Summer-A4-5 | 123.0283 | 31.16658 | 58 | 60.7 | | 25 |
| Summer-A3 | 122.9943 | 30.41872 | 3 | 55 | | 25 |
| Summer-A3 | 122.9943 | 30.41872 | 5 | 55 | | 25 |
| Summer-A3 | 122.9943 | 30.41872 | 30 | 55 | | 25 |
| Summer-A3 | 122.9943 | 30.41872 | 53 | 55 | | 25 |
| Summer-B4 | 122.9995 | 29.85505 | 3 | 57.3 | | 25 |
| Summer-B4 | 122.9995 | 29.85505 | 55 | 57.3 | | 25 |
| Summer-B4 | 122.9995 | 29.85505 | 20 | 57.3 | | 25 |
| Summer-C3 | 122.5103 | 29.498 | 3 | 31.1 | | 25 |
| Summer-C3 | 122.5103 | 29.498 | 5 | 31.1 | | 25 |
| Summer-C3 | 122.5103 | 29.498 | 28 | 31.1 | | 25 |
| Summer-D6 | 122.758 | 28.9809 | 3 | 61.7 | | 25 |
| Summer-D6 | 122.758 | 28.9809 | 11 | 61.7 | | 25 |
| Summer-D6 | 122.758 | 28.9809 | 27 | 61.7 | | 25 |
| Summer-D6 | 122.758 | 28.9809 | 59 | 61.7 | | 25 |
| Summer-E5 | 122.3229 | 28.4535 | 3 | 53.8 | | 25 |
| Summer-E5 | 122.3229 | 28.4535 | 23 | 53.8 | | 25 |
| Summer-E5 | 122.3229 | 28.4535 | 51 | 53.8 | | 25 |
| Summer-F2 | 121.8651 | 28.1616 | 3 | 26.4 | | 25 |
| Summer-F2 | 121.8651 | 28.1616 | 16 | 26.4 | | 25 |
| Summer-F2 | 121.8651 | 28.1616 | 24 | 26.4 | | 25 |
| Summer-G4 | 121.5556 | 27.4121 | 3 | 49 | | 25 |
| Summer-G4 | 121.5556 | 27.4121 | 25 | 49 | | 25 |
| Summer-H5 | 120.9866 | 26.73602 | 3 | 59.5 | | 25 |

**Supplementary Table S2.** The detection limits for nutrients during three cruises.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Cruise | NO2- (μmol L-1) | NO3- (μmol L-1) | NH4+ (μmol L-1) | PO43- (μmol L-1) | SiO32- (μmol L-1) |
| NORC2017-03 | 0.04 | 0.04 | No data available | 0.08 | 0.16 |
| MZ17SP | 0.01 | 0.02 | No data available | 0.01 | 0.01 |
| MZ18SU | 0.01 | 0.02 | 0.02 | 0.04 | 0.01 |

**Supplementary Table S3.** Water masses and their end-member properties which are used in the three end-member mixing model. CDW: Changjiang Diluted Water; TSW: Taiwan Strait Water; KSSW: Kuroshio Subsurface Water.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Season | Water mass | Representative station | Longitude (°E) | Latitude (°N) | Depth (m) | Salinity | Temperature (℃) |
| Spring | CDWa | Station B1 | 122.36 | 30.07 | Average value of entire water column | 26.94±0.11 | 17.65±0.03 |
| TSWb | Station TWS3 | 119.67 | 25.00 | Average value of 1-30 m | 34.19±0.08 | 22.78±0.31 |
| KSSWc | Station 376 | 126.33 | 26.74 | 200 | 34.7±0.1 | 18.9±0.1 |
| Summer | CDWd | Station B1 | 122.36 | 30.07 | Average value of entire water column | 28.19±0.93 | 27.38±0.18 |
| TSWe | Station Y33 | 119.80 | 24.84 | Average value of 1-30 m | 33.74±0.13 | 28.34±0.89 |
| KSSWc | Station 376 | 126.33 | 26.74 | 200 | 34.7±0.1 | 18.9±0.1 |

a, d The end-members for CDW were collected from cruises MZ17SP and MZ18SU.

b, d The end-members for TSW were collected from cruises MZ17SP and NORC2018-04. As the bottom water of the Taiwan Warm Current is affected by the Kuroshio Current in the warm seasons (Bian et al., 2013), mean values of data with depth ＜ 30 m were used as end-members of TSW at stations TWS3 and Y33.

c The end-member for KSSW was from Wang et al. (2016).

**Supplementary Table S4.** The results of Mann-Whitney U test on the relationship between middle and bottom layers, and between surface and deep layers, based on hydrographic parameters and lipid biomarkers in spring and summer . CDW (%), TSW (%) and KSSW (%): the proportions of three water masses. ΣPB: the concentrations of the sum of total sterols. Brassicasterol (%): the proportions of brassicasterol; dinosterol (%): the proportions of dinosterol; TFAs: of the concentrations of total fatty acids; SFAs (%): the proportions of saturated fatty acids; MUFAs (%): the proportions of monounsaturated fatty acids; PUFAs (%): the proportions of polyunsaturated fatty acids. Significant differences are in bold.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Parameters | Middle vs. bottom layers in Spring | | Middle vs. bottom layers in Summer | | Surface vs. deep layers in Spring | | Surface vs. deep layers in Summer | |
| Z | p-value | Z | p-value | Z | p-value | Z | p-value |
| CDW (%) | 1.04 | 0.40 | -0.80 | 0.49 | 3.11 | **0.00** | 2.61 | **0.01** |
| TSW (%) | 1.83 | 0.09 | 1.28 | 0.24 | 0.98 | 0.36 | 2.21 | **0.03** |
| KSSW (%) | -1.57 | 0.18 | -1.28 | 0.24 | -3.16 | **0.00** | -3.67 | **0.00** |
| Temperature (℃) | 1.83 | 0.09 | 1.28 | 0.24 | 0.00 | 1.00 | 3.67 | **0.00** |
| Salinity | -1.04 | 0.40 | -0.64 | 0.59 | -3.55 | **0.00** | -3.35 | **0.00** |
| ΣPB (ng L-1) | 1.83 | 0.09 | 0.80 | 0.49 | 3.55 | **0.00** | 1.14 | 0.28 |
| Brassicasterol (%) | 2.09 | **0.04** | 1.28 | 0.24 | 1.42 | 0.17 | 0.65 | 0.55 |
| Dinosterol (%) | -2.09 | **0.04** | -1.28 | 0.24 | -1.42 | 0.17 | -0.65 | 0.55 |
| TFAs (μg L-1) | 0.52 | 0.71 | -1.12 | 0.31 | 1.33 | 0.20 | 1.88 | 0.07 |
| SFAs (%) | -0.78 | 0.53 | 0.32 | 0.82 | -2.13 | **0.03** | 1.14 | 0.28 |
| MUFAs (%) | 0.00 | 1.00 | -0.48 | 0.70 | 1.69 | 0.10 | -0.49 | 0.66 |
| PUFAs (%) | 1.57 | 0.18 | -0.32 | 0.82 | 2.22 | **0.03** | -2.94 | **0.00** |

**Supplementary Table S5.** PCA loadings of the proportions of water masses (CDW: Changjiang Diluted Water; KSSW: Kuroshio Subsurface Water; TSW: Taiwan Strait Water) at each station in the surface and deep layer in spring 2017 and summer 2018.

|  |  |  |
| --- | --- | --- |
| Sample | PC1 | PC2 |
| Spring-A2-3-surface layer | -0.558 | 1.202 |
| Spring-B4-surface layer | -0.541 | 0.554 |
| Spring-A3-surface layer | -0.530 | 0.705 |
| Summer-D6-3-surface layer | -0.508 | -0.233 |
| Summer-H5-3-surface layer | -0.503 | -0.949 |
| Summer-C3-3-surface layer | -0.500 | 0.139 |
| Summer-B4-3-surface layer | -0.499 | -0.267 |
| Summer-F2-3-surface layer | -0.487 | -0.687 |
| Summer-E5-3-surface layer | -0.476 | -0.908 |
| Summer-A3-3-surface layer | -0.469 | 0.512 |
| Spring-C3-surface layer | -0.425 | 0.885 |
| Summer-G4-3-surface layer | -0.417 | -1.012 |
| Spring-A3-8-surface layer | -0.353 | 0.518 |
| Spring-F2-surface layer | -0.352 | 0.633 |
| Summer-A2-4-3-surface layer | -0.337 | -0.106 |
| Summer-A4-5-3-surface layer | -0.331 | 0.276 |
| Spring-F2-deep layer | -0.309 | 0.648 |
| Spring-H5-surface layer | -0.280 | -0.265 |
| Spring-G4-surface layer | -0.237 | -0.332 |
| Spring-D6-surface layer | -0.182 | 0.585 |
| Summer-F2-deep layer | -0.144 | -0.664 |
| Spring-G4-deep layer | -0.120 | -0.677 |
| Spring-E5-surface layer | -0.109 | 0.149 |
| Summer-B4-deep layer | -0.099 | -0.726 |
| Summer-G4-deep layer | 0.232 | -0.502 |
| Summer-A2-4-deep layer | 0.232 | -0.029 |
| Spring-H5-deep layer | 0.473 | -0.172 |
| Summer-E5-deep layer | 0.499 | -0.248 |
| Spring-A3-deep layer | 0.651 | -0.019 |
| Spring-C3-deep layer | 0.695 | 0.354 |
| Spring-B4-deep layer | 0.737 | -0.090 |
| Summer-D6-deep layer | 0.755 | 0.033 |
| Summer-C3-deep layer | 0.799 | 0.173 |
| Summer-A4-5-deep layer | 0.803 | 0.049 |
| Summer-A3-deep layer | 0.905 | 0.186 |
| Spring-E5-deep layer | 0.988 | 0.144 |
| Spring-D6-deep layer | 0.994 | 0.143 |

**Supplementary Table S6.** Per-liter concentrations of total sterols (ng L-1) and POC (mg L-1), and organic carbon-normalized concentrations of sterols (μg mg-1 C-1) in spring and summer.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Season | ΣPB (ng L−1) | POC (mg L-1) | ΣPB (μg mg-1 C-1) | Brassicasterol (μg mg-1 C-1) | Dinosterol (μg mg-1 C-1) |
| Spring (excluding station A2-3) | 49 ~ 1738 | 0.22 ~ 3.76 | 0.13 ~ 2.32 | 0.10 ~ 2.26 | 0.01 ~ 0.45 |
| Spring (station A2-3) | 195 | 5.83 | 0.03 | 0.02 | 0.01 |
| Summer (including all stations) | 53~ 2125 | 0.12 ~ 1.48 | 0.19 ~ 2.00 | 0.08 ~ 1.95 | 0.03 ~ 0.36 |

**Supplementary Table S7.** Proportions of individual fatty acids (% of total fatty acids) in the surface and deep layer at each station in spring and summer.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Station | 14:0 | 14:1 | 16:0 | 16:1 | 18:0 | 18:1n-9c | 18:2n-6t | 18:2n-6c | 20:0 | 18:3n-6 | 20:1 | 18:3n-3 | 20:2n-6 | 22:0 | 22:1n-9 | 20:3n-3 | 20:4n-6 | 22:2n-6 | 24:0 | 20:5n-3 | 24:1n-9 | 22:6n-3 |
| Spring-A3-8-surface layer | 4.40% | 0.00% | 44.20% | 7.70% | 21.30% | 1.60% | 1.30% | 3.20% | 8.30% | 0.00% | 0.00% | 0.20% | 2.30% | 1.60% | 1.10% | 0.20% | 0.00% | 0.00% | 2.10% | 0.20% | 0.30% | 0.20% |
| Spring-A2-3-surface layer | 0.80% | 0.00% | 56.60% | 1.90% | 35.50% | 0.60% | 0.20% | 0.50% | 0.90% | 0.00% | 0.00% | 0.10% | 0.40% | 0.90% | 0.50% | 0.10% | 0.10% | 0.10% | 0.60% | 0.10% | 0.20% | 0.00% |
| Spring-A3-surface layer | 9.90% | 0.10% | 56.70% | 6.70% | 17.80% | 3.70% | 0.00% | 0.90% | 1.50% | 0.10% | 0.30% | 0.70% | 0.00% | 0.30% | 0.10% | 0.00% | 0.10% | 0.00% | 0.20% | 0.40% | 0.10% | 0.20% |
| Spring-A3-deep layer | 7.60% | 0.10% | 51.00% | 6.80% | 26.50% | 2.80% | 0.10% | 0.30% | 0.70% | 0.10% | 2.30% | 0.10% | 0.10% | 0.20% | 0.20% | 0.00% | 0.10% | 0.40% | 0.20% | 0.10% | 0.30% | 0.10% |
| Spring-B4-surface layer | 13.40% | 0.10% | 51.40% | 14.00% | 13.60% | 3.60% | 0.10% | 0.80% | 1.30% | 0.00% | 0.10% | 0.50% | 0.00% | 0.20% | 0.10% | 0.00% | 0.10% | 0.00% | 0.20% | 0.30% | 0.10% | 0.20% |
| Spring-B4-deep layer-1 | 16.50% | 0.20% | 51.70% | 13.20% | 7.40% | 5.30% | 0.10% | 1.80% | 0.90% | 0.10% | 0.10% | 1.00% | 0.00% | 0.30% | 0.10% | 0.10% | 0.10% | 0.10% | 0.20% | 0.50% | 0.10% | 0.40% |
| Spring-B4-deep layer-2 | 4.20% | 0.00% | 57.20% | 3.40% | 30.80% | 2.00% | 0.00% | 0.30% | 0.70% | 0.00% | 0.30% | 0.20% | 0.00% | 0.20% | 0.20% | 0.00% | 0.00% | 0.00% | 0.20% | 0.10% | 0.20% | 0.20% |
| Spring-C3--surface layer | 16.70% | 0.10% | 52.90% | 7.00% | 11.50% | 5.30% | 0.10% | 1.20% | 2.90% | 0.10% | 0.10% | 0.80% | 0.00% | 0.30% | 0.00% | 0.00% | 0.10% | 0.00% | 0.20% | 0.40% | 0.00% | 0.40% |
| Spring-C3-deep layer-1 | 5.00% | 0.00% | 55.70% | 4.20% | 29.40% | 1.90% | 0.00% | 0.30% | 1.30% | 0.00% | 0.30% | 0.20% | 0.00% | 0.30% | 0.30% | 0.00% | 0.00% | 0.00% | 0.50% | 0.20% | 0.30% | 0.00% |
| Spring-C3-deep layer-2 | 17.50% | 0.10% | 52.50% | 8.00% | 12.20% | 3.30% | 0.10% | 1.20% | 1.10% | 0.10% | 0.10% | 1.20% | 0.00% | 0.30% | 0.10% | 0.10% | 0.20% | 0.30% | 0.20% | 0.80% | 0.10% | 0.40% |
| Spring-D6-surface layer | 12.70% | 0.10% | 38.00% | 39.10% | 4.50% | 1.80% | 0.20% | 0.70% | 1.50% | 0.10% | 0.10% | 0.30% | 0.30% | 0.10% | 0.00% | 0.00% | 0.00% | 0.10% | 0.10% | 0.20% | 0.00% | 0.10% |
| Spring-D6-deep layer | 4.20% | 0.00% | 54.40% | 8.60% | 26.60% | 2.00% | 0.00% | 0.40% | 1.30% | 0.00% | 0.40% | 0.30% | 0.30% | 0.20% | 0.20% | 0.00% | 0.00% | 0.00% | 0.40% | 0.30% | 0.30% | 0.20% |
| Spring-E5--surface layer | 16.60% | 0.10% | 42.70% | 7.90% | 19.60% | 1.40% | 0.10% | 0.20% | 10.20% | 0.00% | 0.00% | 0.00% | 0.10% | 0.20% | 0.10% | 0.10% | 0.10% | 0.00% | 0.40% | 0.10% | 0.00% | 0.10% |
| Spring-E5-deep layer-1 | 13.30% | 0.10% | 49.10% | 10.00% | 19.30% | 2.20% | 0.10% | 0.70% | 2.90% | 0.10% | 0.40% | 0.20% | 0.30% | 0.20% | 0.20% | 0.00% | 0.10% | 0.00% | 0.30% | 0.20% | 0.20% | 0.20% |
| Spring-E5-deep layer-2 | 3.80% | 0.10% | 57.70% | 3.00% | 32.20% | 1.00% | 0.00% | 0.20% | 0.90% | 0.00% | 0.10% | 0.00% | 0.00% | 0.20% | 0.40% | 0.00% | 0.00% | 0.00% | 0.30% | 0.00% | 0.00% | 0.00% |
| Spring-F2--surface layer | 15.40% | 0.10% | 41.80% | 26.00% | 9.80% | 0.70% | 0.10% | 0.70% | 3.90% | 0.10% | 0.10% | 0.30% | 0.30% | 0.10% | 0.00% | 0.00% | 0.00% | 0.10% | 0.20% | 0.20% | 0.10% | 0.10% |
| Spring-F2-deep layer | 4.50% | 0.10% | 56.50% | 5.40% | 27.80% | 1.60% | 0.00% | 0.40% | 1.80% | 0.10% | 0.30% | 0.20% | 0.10% | 0.20% | 0.20% | 0.10% | 0.10% | 0.00% | 0.30% | 0.10% | 0.20% | 0.10% |
| Spring-G4--surface layer | 11.70% | 0.00% | 48.60% | 8.40% | 21.50% | 2.00% | 0.10% | 0.40% | 5.80% | 0.00% | 0.10% | 0.10% | 0.10% | 0.20% | 0.00% | 0.00% | 0.00% | 0.00% | 0.30% | 0.20% | 0.10% | 0.20% |
| Spring-G4-deep layer-1 | 9.00% | 0.10% | 53.40% | 7.70% | 24.10% | 2.20% | 0.10% | 0.50% | 1.60% | 0.00% | 0.10% | 0.10% | 0.10% | 0.20% | 0.10% | 0.00% | 0.10% | 0.00% | 0.20% | 0.20% | 0.10% | 0.20% |
| Spring-G4-deep layer-2 | 2.70% | 0.00% | 57.60% | 2.40% | 34.50% | 0.90% | 0.00% | 0.20% | 0.60% | 0.00% | 0.10% | 0.10% | 0.10% | 0.20% | 0.10% | 0.00% | 0.00% | 0.00% | 0.20% | 0.10% | 0.10% | 0.10% |
| Spring-H5--surface layer | 7.80% | 0.00% | 48.00% | 4.20% | 27.00% | 1.70% | 0.00% | 0.50% | 8.10% | 0.00% | 0.00% | 0.20% | 0.00% | 0.20% | 0.00% | 0.00% | 0.10% | 0.00% | 0.50% | 0.50% | 0.00% | 0.80% |
| Spring-H5-deep layer-1 | 5.10% | 0.00% | 56.40% | 3.70% | 28.50% | 1.20% | 0.10% | 0.50% | 1.40% | 0.00% | 0.00% | 0.60% | 0.10% | 0.10% | 0.00% | 0.10% | 0.00% | 0.00% | 0.10% | 0.80% | 0.10% | 1.00% |
| Spring-H5-deep layer-2 | 4.20% | 0.00% | 57.50% | 4.10% | 30.20% | 1.00% | 0.00% | 0.50% | 0.60% | 0.00% | 0.10% | 0.30% | 0.10% | 0.10% | 0.10% | 0.10% | 0.00% | 0.00% | 0.20% | 0.60% | 0.00% | 0.40% |
| Summer-A2-4-surface layer | 28.60% | 0.00% | 34.50% | 22.10% | 4.40% | 1.70% | 0.00% | 0.50% | 3.70% | 0.10% | 0.00% | 0.10% | 0.50% | 0.80% | 0.40% | 0.00% | 0.20% | 0.00% | 0.80% | 0.70% | 0.30% | 0.40% |
| Summer-A2-4-deep layer | 10.00% | 0.00% | 56.80% | 5.20% | 10.00% | 6.60% | 0.00% | 0.50% | 2.50% | 0.10% | 0.10% | 0.30% | 0.20% | 0.60% | 0.20% | 0.00% | 0.10% | 0.00% | 0.60% | 2.60% | 0.10% | 3.60% |
| Summer-A4-5-surface layer | 25.20% | 0.10% | 37.10% | 19.80% | 4.60% | 3.30% | 0.20% | 0.80% | 2.30% | 0.00% | 0.20% | 0.50% | 0.90% | 0.30% | 0.20% | 0.30% | 0.10% | 0.10% | 0.50% | 2.50% | 0.10% | 1.00% |
| Summer-A4-5-deep layer | 10.40% | 0.10% | 50.60% | 9.20% | 22.10% | 2.20% | 0.10% | 0.60% | 1.30% | 0.10% | 0.10% | 0.30% | 0.20% | 0.20% | 0.20% | 0.10% | 0.00% | 0.00% | 0.30% | 1.30% | 0.00% | 0.60% |
| Summer-A3-surface layer | 25.80% | 0.10% | 43.30% | 19.30% | 3.50% | 2.80% | 0.30% | 1.10% | 0.50% | 0.50% | 0.10% | 0.40% | 0.30% | 0.30% | 0.20% | 0.10% | 0.00% | 0.10% | 0.30% | 0.80% | 0.00% | 0.40% |
| Summer-A3-deep layer-1 | 22.30% | 0.10% | 40.30% | 17.90% | 5.70% | 3.50% | 0.20% | 1.00% | 1.70% | 0.30% | 0.10% | 0.70% | 0.40% | 0.50% | 0.40% | 0.10% | 0.10% | 0.00% | 0.70% | 2.50% | 0.10% | 1.30% |
| Summer-A3-deep layer-2 | 9.20% | 0.10% | 43.40% | 11.30% | 16.20% | 4.80% | 0.30% | 1.20% | 3.30% | 0.30% | 0.50% | 0.80% | 0.30% | 0.90% | 1.00% | 0.10% | 0.20% | 0.20% | 1.80% | 1.80% | 0.20% | 2.20% |
| Summer-B4-surface layer | 5.90% | 0.00% | 44.90% | 4.30% | 23.50% | 1.50% | 0.00% | 0.30% | 15.10% | 0.10% | 0.10% | 0.20% | 0.00% | 0.70% | 0.10% | 0.00% | 0.20% | 0.20% | 1.20% | 0.60% | 0.10% | 1.10% |
| Summer-B4-deep layer | 7.00% | 0.10% | 44.00% | 8.70% | 22.20% | 3.90% | 0.10% | 1.40% | 4.70% | 0.20% | 0.30% | 0.70% | 0.10% | 0.60% | 0.30% | 0.10% | 0.20% | 0.30% | 0.90% | 2.00% | 0.10% | 2.30% |
| Summer-C3-surface layer | 23.20% | 0.20% | 45.70% | 21.20% | 3.00% | 2.40% | 0.10% | 1.00% | 0.20% | 0.10% | 0.00% | 0.50% | 0.20% | 0.30% | 0.00% | 0.00% | 0.00% | 0.10% | 0.20% | 0.80% | 0.00% | 0.60% |
| Summer-C3-deep layer-1 | 21.50% | 0.20% | 41.70% | 21.80% | 6.50% | 3.30% | 0.20% | 1.40% | 0.20% | 0.20% | 0.10% | 0.40% | 0.30% | 0.30% | 0.10% | 0.00% | 0.00% | 0.10% | 0.20% | 1.00% | 0.00% | 0.40% |
| Summer-C3-deep layer-2 | 7.10% | 0.20% | 43.90% | 8.70% | 10.80% | 20.10% | 0.00% | 4.90% | 0.70% | 0.10% | 0.20% | 0.30% | 0.10% | 0.90% | 0.10% | 0.00% | 0.10% | 0.10% | 0.60% | 0.60% | 0.00% | 0.30% |
| Summer-D6-surface layer | 14.50% | 0.00% | 50.60% | 7.80% | 16.20% | 5.90% | 0.10% | 0.80% | 1.00% | 0.10% | 0.10% | 0.30% | 0.00% | 0.30% | 0.10% | 0.00% | 0.10% | 0.10% | 0.30% | 0.60% | 0.10% | 0.90% |
| Summer-D6-deep layer-1 | 12.60% | 0.10% | 49.80% | 8.80% | 16.30% | 5.60% | 0.10% | 0.80% | 1.60% | 0.10% | 0.10% | 0.40% | 0.10% | 0.50% | 0.10% | 0.00% | 0.10% | 0.20% | 0.50% | 0.80% | 0.10% | 1.20% |
| Summer-D6-deep layer-2 | 3.10% | 0.00% | 52.80% | 5.40% | 28.20% | 3.10% | 0.20% | 0.80% | 1.60% | 0.10% | 0.20% | 0.30% | 0.00% | 0.60% | 0.20% | 0.00% | 0.20% | 0.30% | 0.90% | 1.00% | 0.10% | 0.80% |
| Summer-D6-deep layer-3 | 3.40% | 0.10% | 37.70% | 6.40% | 13.40% | 27.90% | 0.10% | 7.10% | 1.00% | 0.10% | 0.30% | 0.30% | 0.10% | 0.90% | 0.10% | 0.00% | 0.10% | 0.10% | 0.60% | 0.30% | 0.10% | 0.20% |
| Summer-E5-surface layer | 12.20% | 0.10% | 50.60% | 6.80% | 20.80% | 5.50% | 0.10% | 0.90% | 0.70% | 0.00% | 0.10% | 0.30% | 0.10% | 0.30% | 0.20% | 0.00% | 0.10% | 0.10% | 0.40% | 0.30% | 0.10% | 0.50% |
| Summer-E5-deep layer-1 | 23.80% | 0.20% | 40.00% | 18.50% | 7.00% | 3.20% | 0.10% | 1.20% | 0.40% | 0.20% | 0.10% | 0.80% | 0.10% | 0.40% | 0.10% | 0.00% | 0.10% | 0.20% | 0.60% | 2.00% | 0.10% | 0.80% |
| Summer-E5-deep layer-2 | 11.40% | 0.10% | 49.50% | 10.10% | 18.20% | 4.30% | 0.10% | 1.00% | 0.90% | 0.10% | 0.20% | 0.50% | 0.00% | 0.60% | 0.20% | 0.00% | 0.20% | 0.30% | 0.80% | 0.90% | 0.10% | 0.60% |
| Summer-F2-surface layer | 10.00% | 0.10% | 51.80% | 7.50% | 23.80% | 3.30% | 0.00% | 0.50% | 0.60% | 0.00% | 0.10% | 0.20% | 0.00% | 0.30% | 0.30% | 0.00% | 0.20% | 0.00% | 0.40% | 0.30% | 0.10% | 0.30% |
| Summer-F2-deep layer-1 | 17.70% | 0.20% | 49.80% | 12.20% | 11.50% | 4.20% | 0.10% | 0.70% | 0.40% | 0.10% | 0.10% | 0.50% | 0.00% | 0.30% | 0.20% | 0.00% | 0.30% | 0.10% | 0.40% | 0.70% | 0.10% | 0.50% |
| Summer-F2-deep layer-2 | 5.20% | 0.10% | 53.60% | 10.60% | 19.10% | 5.00% | 0.10% | 0.90% | 0.60% | 0.10% | 0.40% | 0.70% | 0.00% | 0.40% | 0.20% | 0.00% | 0.40% | 0.10% | 0.60% | 1.20% | 0.10% | 0.50% |
| Summer-G4-surface layer | 8.30% | 0.10% | 53.00% | 6.40% | 24.80% | 3.80% | 0.00% | 0.60% | 0.60% | 0.00% | 0.10% | 0.20% | 0.00% | 0.20% | 0.10% | 0.10% | 0.10% | 0.00% | 0.20% | 0.50% | 0.10% | 0.70% |
| Summer-G4-deep layer | 3.40% | 0.10% | 54.70% | 5.20% | 24.00% | 6.10% | 0.10% | 1.20% | 0.70% | 0.10% | 0.30% | 0.50% | 0.10% | 0.30% | 0.30% | 0.10% | 0.20% | 0.10% | 0.30% | 0.80% | 0.20% | 1.30% |
| Summer-H5-surface layer | 8.10% | 0.10% | 50.80% | 5.60% | 28.80% | 2.90% | 0.10% | 0.60% | 0.50% | 0.00% | 0.10% | 0.20% | 0.00% | 0.30% | 0.50% | 0.00% | 0.10% | 0.10% | 0.20% | 0.30% | 0.10% | 0.60% |

**Supplementary Table S8.** PCA loadings of the proportions (%) of lipid biomarkers at each station in the surface and deep layer in spring 2017 and summer 2018. FAs with the proportions below 0.5% were excluded.

|  |  |  |
| --- | --- | --- |
| Sample | PC1 | PC2 |
| Spring-A3-8-surface layer | -2.478 | 2.336 |
| Summer-A3-deep layer | -1.853 | 0.585 |
| Summer-A4-5-surface layer | -1.325 | -0.665 |
| Summer-A2-4-surface layer | -1.225 | -0.207 |
| Summer-B4-deep layer | -0.963 | 0.337 |
| Summer-C3-deep layer | -0.866 | -1.635 |
| Summer-A2-4-deep layer | -0.691 | 0.114 |
| Summer-E5-deep layer | -0.579 | -0.848 |
| Summer-D6-deep layer | -0.554 | -0.489 |
| Summer-A3-surface layer | -0.465 | -0.918 |
| Summer-B4-surface layer | -0.442 | 1.395 |
| Summer-C3-surface layer | -0.253 | -2.067 |
| Spring-D6-surface layer | -0.245 | -0.637 |
| Spring-F2-surface layer | -0.055 | -0.160 |
| Summer-F2-deep layer | 0.010 | -0.809 |
| Spring-C3-surface layer | 0.127 | -0.870 |
| Summer-D6-surface layer | 0.182 | -0.683 |
| Summer-A4-5-deep layer | 0.184 | -0.070 |
| Summer-G4-deep layer | 0.199 | -0.118 |
| Spring-E5-surface layer | 0.202 | 0.681 |
| Spring-H5-surface layer | 0.294 | 0.821 |
| Summer-E5-surface layer | 0.316 | -0.196 |
| Spring-B4-surface layer | 0.339 | -0.697 |
| Spring-A2-3-surface layer | 0.455 | 0.891 |
| Spring-G4-surface layer | 0.458 | 0.525 |
| Summer-F2-surface layer | 0.458 | 0.142 |
| Spring-A3-surface layer | 0.470 | -0.536 |
| Summer-H5-surface layer | 0.484 | 0.524 |
| Spring-D6-deep layer | 0.618 | 0.379 |
| Summer-G4-surface layer | 0.628 | -0.054 |
| Spring-H5-deep layer | 0.798 | 0.406 |
| Spring-C3-deep layer | 0.817 | 0.119 |
| Spring-F2-deep layer | 0.847 | 0.634 |
| Spring-G4-deep layer | 0.962 | 0.571 |
| Spring-A3-deep layer | 1.007 | 0.171 |
| Spring-E5-deep layer | 1.033 | 0.953 |
| Spring-B4-deep layer | 1.105 | 0.078 |

**Supplementary Table S9.** PCA loadings of the proportions (%) of lipid biomarkers under the dominance of different water masses in the surface and deep layer in spring 2017 and summer 2018. FAs with the proportions below 0.5% were excluded.

|  |  |  |
| --- | --- | --- |
| Station | PC1 | PC2 |
| Summer-C3-deep | -1.943 | -1.353 |
| Summer-B4-surface | -1.736 | 1.593 |
| Spring-A3- deep layer | -1.294 | -2.140 |
| Spring-A3-surface layer | -1.251 | 1.372 |
| Spring-C3- deep layer | -1.218 | 0.559 |
| Spring-C3-surface layer | -1.216 | 0.971 |
| Summer-H5-surface | -1.078 | -0.450 |
| Summer-D6-deep | -1.068 | -0.638 |
| Spring-B4-surface layer | -0.945 | 0.562 |
| Summer-F2-surface | -0.878 | -0.560 |
| Summer-G4-surface | -0.743 | -0.947 |
| Spring-E5- deep layer | -0.692 | 1.983 |
| Spring-B4- deep layer | -0.499 | 0.804 |
| Summer-G4-deep | -0.406 | 0.832 |
| Summer-E5-surface | -0.328 | -0.966 |
| Spring-D6-surface layer | -0.323 | -1.490 |
| Spring-F2-surface layer | -0.159 | -1.378 |
| Summer-E5-deep | -0.132 | 0.096 |
| Spring-G4-surface layer | -0.022 | -0.603 |
| Summer-A4-5-deep | -0.002 | 1.332 |
| Summer-D6-surface | 0.007 | -1.033 |
| Spring-H5-surface layer | 0.035 | -0.368 |
| Spring-F2- deep layer | 0.257 | 0.024 |
| Spring-D6- deep layer | 0.350 | -1.193 |
| Spring-E5-surface layer | 0.358 | -1.324 |
| Summer-A2-4-surface | 0.423 | 1.990 |
| Spring-G4- deep layer | 0.539 | -0.097 |
| Spring-A2-3-surface layer | 0.769 | 1.520 |
| Summer-A2-4-deep | 0.922 | 1.589 |
| Summer-A3-surface | 1.136 | -0.013 |
| Summer-B4-deep | 1.268 | -0.158 |
| Summer-A4-5-surface | 1.292 | 1.285 |
| Summer-C3-surface | 1.904 | -0.899 |
| Summer-A3-deep | 1.942 | -2.065 |
| Spring-H5- deep layer | 2.558 | 0.059 |
| Spring-A3-8-surface layer | 2.753 | 0.738 |