The following supplement accompanies the article

**Linking marine benthic biodiversity and ecosystem functions related to carbon cycling in a continental mud depocenter**

**Table S1. Traits to estimated bioturbation and bioirrigation potential, including sediment particle reworking (R), mobility (M), burrow type (Bt), feeding type (FT), and injection pocked depth (ID), with the respective categories and scores.**

| Trait | Score | Category |
|---|---|---|
| Sediment particle reworking (R) | 1 | Epifauna. |
| | 2 | Surficial modifiers. |
| | 3 | Upward /downward conveyors. |
| | 4 | Biodiffusors. |
| | 5 | Regenerators. |
| Mobility (M) | 1 | Organisms that live in fixed tubes. |
| | 2 | Limited movement. |
| | 3 | Slow, free movement through the sediment matrix. |
| | 4 | Free movement burrow system. |
| Burrow type (Bt) | 1 | Epifauna, internal irrigation (e.g. Siphons). |
| | 2 | Open irrigation (U- or Y-shape burrows). |
| | 3 | Blind ended irrigation (e.g.blind ended burrows, no burrow systems). |
| Feeding type (FT) | 1 | Surface filter feeder. |
| | 2 | Predator. |
| | 3 | Deposit feeder. |
| | 4 | Subsurface filter feeder. |
| Injection pocket depth (ID) | 1 | 0–2 cm. |
| | 2 | 2–5 cm. |
| | 3 | 5–10 cm. |
| | 4 | > 10 cm. |

**Table S2. Analysis of variance (ANOVA) table for the comparison of the infauna ash-free dry mass between the four infauna clusters.**

| Source | Df | Sum of squares | Mean square | F-value | p (> F) |
|---|---|---|---|---|---|
| Cluster | 3 | 31.88 | 10.626 | 2.264 | 0.0936 |
| Residuals | 46 | 215.88 | 4.693 | | |

**Table S3. Permutation analysis of variance (PERMANOVA) to compare the biomass-based community composition between the four infauna clusters based on 9999 permutations.**

| Source | Df | Sum of squares | $R^2$ | F-value | p (> F) |
|---|---|---|---|---|---|
| Model | 3 | 1.3901 | 0.50156 | 15.429 | 0.0001 |
| Residual | 46 | 1.3815 | 0.49844 | | |
| Total | 49 | 2.7715 | | | |

**Table S4. Summary of distance-based redundancy analysis (dbRDA) to identify the environmental variables that best explained the dissimilarities among the infauna community. Significant results ($p < 0.05$) are shown in bold.**

| Source | Df | Sum of squares | F-value | p (> F) |
|---|---|---|---|---|
| Model | 13 | 5.0531 | 3.38 | **0.0001** |
| Residual | 36 | 4.1400 | | |
| Environmental variable | Df | Sum of squares | F-value | p (> F) |
| Sorting | 1 | 0.3503 | 3.0457 | **0.0054** |
| Skewness | 1 | 0.5157 | 4.4846 | **0.0002** |
| Kurtosis | 1 | 1.0112 | 8.7929 | **0.0001** |
| D10 | 1 | 0.1764 | 1.5336 | 0.1136 |
| D50 | 1 | 0.4312 | 3.7497 | **0.0014** |
| D90 | 1 | 0.3652 | 3.1761 | **0.0048** |
| % Sand | 1 | 0.1400 | 1.2178 | 0.2285 |
| % Clay | 1 | 0.2591 | 2.2534 | 0.0280 |
| % Silt | 1 | 0.1647 | 1.4320 | 0.1493 |
| OC | 1 | 0.0734 | 0.6379 | 0.8033 |
| Salinity | 1 | 0.8689 | 7.5553 | **0.0001** |
| Bottom shear stress | 1 | 0.5818 | 5.0587 | **0.0002** |
| Depth | 1 | 0.1153 | 1.0026 | 0.3903 |
| Residual | 36 | 4.1400 | | |

**Table S5. Summary of the simple slope analysis to explore the biodiversity-ecosystem function relationship along environmental gradients. The t-value indicates how strongly the slope differs from zero, and the p-value represents the probability of observing this t-value if the true slope was zero. Significant results ($p < 0.05$) are shown in bold.**

| Ecosystem function | Diversity index | Interaction environmental variables | Moderator value | Slope | Standard Error | t-value | p-value |
|---|---|---|---|---|---|---|---|
| $BP_C$ | $^1D$ | Bottom shear stress | -1 S.D. | 0.91 | 7.95 | -3.10 | **0.00** |
| | | | Mean | 1.09 | 4.34 | -2.20 | **0.03** |
| | | | +1 S.D. | 1.27 | 4.78 | 1.15 | 0.26 |
| $BP_C$ | $^1D$ | Salinity | -1 S.D. | 30.08 | 6.50 | 1.22 | 0.23 |
| | | | Mean | 31.24 | 4.16 | -1.71 | 0.09 |
| | | | +1 S.D. | 32.40 | 6.80 | -3.26 | **0.00** |
| $BP_C$ | $^2D$ | Bottom shear stress | -1 S.D. | 0.91 | 12.20 | -3.48 | **0.00** |
| | | | Mean | 1.09 | 6.37 | -2.78 | **0.01** |
| | | | +1 S.D. | 1.27 | 6.85 | 1.02 | 0.31 |
| $BP_C$ | $^2D$ | Salinity | -1 S.D. | 30.08 | 8.76 | 0.94 | 0.35 |
| | | | Mean | 31.24 | 6.10 | -2.08 | **0.04** |
| | | | +1 S.D. | 32.40 | 10.01 | -3.35 | **0.00** |
| $BP_C$ | $E_{1,0}$ | Bottom shear stress | -1 S.D. | 0.91 | 236.42 | -4.65 | **0.00** |
| | | | Mean | 1.09 | 150.45 | -4.16 | **0.00** |
| | | | +1 S.D. | 1.27 | 218.32 | -0.70 | 0.48 |
| $BP_C$ | $E_{1,0}$ | Salinity | -1 S.D. | 30.08 | 208.54 | -1.13 | 0.26 |
| | | | Mean | 31.24 | 160.61 | -4.55 | **0.00** |
| | | | +1 S.D. | 32.40 | 226.63 | -5.41 | **0.00** |
| $BP_C$ | $E_{1,0}$ | D50 | -1 S.D. | 34.88 | 255.82 | -5.20 | **0.00** |
| | | | Mean | 75.86 | 172.35 | -5.15 | **0.00** |
| | | | +1 S.D. | 116.83 | 207.46 | -2.15 | **0.04** |
| $BP_C$ | $E_{1,0}$ | D90 | -1 S.D. | 81.34 | 254.88 | -5.29 | **0.00** |
| | | | Mean | 164.01 | 168.45 | -5.55 | **0.00** |
| | | | +1 S.D. | 246.69 | 204.36 | -2.55 | **0.01** |
| $BP_C$ | $E_{1,0}$ | Clay | -1 S.D. | 0.03 | 235.10 | -1.84 | 0.07 |
| | | | Mean | 0.05 | 180.56 | -4.99 | **0.00** |
| | | | +1 S.D. | 0.07 | 289.35 | -4.74 | **0.00** |
| $IP_C$ | $^1D$ | Bottom shear stress | -1 S.D. | 0.91 | 5.49 | -3.23 | **0.00** |
| | | | Mean | 1.09 | 3.00 | -2.30 | **0.03** |
| | | | +1 S.D. | 1.27 | 3.30 | 1.20 | 0.24 |
| $IP_C$ | $^1D$ | Salinity | -1 S.D. | 30.08 | 5.41 | 1.35 | 0.18 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | Mean | 31.24 | 3.46 | -2.20 | **0.03** |
| | | | +1 S.D. | 32.40 | 5.65 | -3.98 | **0.00** |
| | | | -1 S.D. | 0.91 | 8.37 | -3.70 | **0.00** |
| $IP_C$ | $^2D$ | Bottom shear stress | Mean | 1.09 | 4.37 | -2.90 | **0.01** |
| | | | +1 S.D. | 1.27 | 4.70 | 1.20 | 0.24 |
| | | | -1 S.D. | 30.08 | 7.38 | 1.10 | 0.28 |
| $IP_C$ | $^2D$ | Salinity | Mean | 31.24 | 5.14 | -2.36 | 0.02 |
| | | | +1 S.D. | 32.40 | 8.44 | -3.83 | **0.00** |
| | | | -1 S.D. | 0.91 | 158.08 | -5.37 | **0.00** |
| $IP_C$ | $E_{1,0}$ | Bottom shear stress | Mean | 1.09 | 100.60 | -4.01 | **0.00** |
| | | | +1 S.D. | 1.27 | 145.98 | 0.29 | 0.77 |
| | | | -1 S.D. | 30.08 | 182.30 | -0.53 | 0.60 |
| $IP_C$ | $E_{1,0}$ | Salinity | Mean | 31.24 | 140.40 | -4.13 | **0.00** |
| | | | +1 S.D. | 32.40 | 198.11 | -5.36 | **0.00** |
| | | | -1 S.D. | 34.88 | 230.58 | -4.77 | **0.00** |
| $IP_C$ | $E_{1,0}$ | D50 | Mean | 75.86 | 155.35 | -4.63 | **0.00** |
| | | | +1 S.D. | 116.83 | 186.99 | -1.81 | 0.08 |
| | | | -1 S.D. | 81.34 | 234.01 | -4.72 | **0.00** |
| $IP_C$ | $E_{1,0}$ | D90 | Mean | 164.01 | 154.66 | -4.74 | **0.00** |
| | | | +1 S.D. | 246.69 | 187.63 | -1.92 | 0.06 |
| | | | -1 S.D. | 0.03 | 202.99 | -1.30 | 0.20 |
| $IP_C$ | $E_{1,0}$ | Clay | Mean | 0.05 | 155.90 | -4.70 | **0.00** |
| | | | +1 S.D. | 0.07 | 249.83 | -4.81 | **0.00** |
| | | | -1 S.D. | 0.91 | 188.87 | -3.68 | **0.00** |
| P | $FR_{ed}$ | Bottom shear stress | Mean | 1.09 | 160.47 | -1.26 | 0.21 |
| | | | +1 S.D. | 1.27 | 245.76 | 1.18 | 0.24 |
| | | | -1 S.D. | 30.08 | 428.30 | 2.39 | **0.02** |
| P | $FR_{ed}$ | Salinity | Mean | 31.24 | 185.37 | 0.30 | 0.76 |
| | | | +1 S.D. | 32.40 | 237.53 | -3.83 | **0.00** |
| | | | -1 S.D. | 0.92 | 244.51 | -0.15 | 0.88 |
| P | $FR_{ed}$ | Kurtosis | Mean | 1.43 | 173.19 | -2.03 | 0.05 |
| | | | +1 S.D. | 1.94 | 198.94 | -3.35 | **0.00** |
| | | | -1 S.D. | 0.91 | 601.42 | -3.49 | **0.00** |
| R | $FR_{ed}$ | Bottom shear stress | Mean | 1.09 | 510.96 | -0.87 | 0.39 |
| | | | +1 S.D. | 1.27 | 782.57 | 1.54 | 0.13 |
| | | | -1 S.D. | 30.08 | 1295.57 | 2.88 | **0.01** |
| R | $FR_{ed}$ | Salinity | Mean | 31.24 | 560.74 | 0.81 | 0.42 |
| | | | +1 S.D. | 32.40 | 718.53 | -3.93 | **0.00** |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | -1 S.D. | 0.92 | 804.50 | 0.08 | 0.94 |
| R | $FR_{ed}$ | Kurtosis | Mean | 1.43 | 569.83 | -1.66 | 0.10 |
| | | | +1 S.D. | 1.94 | 654.57 | -3.00 | **0.00** |

**Figure S1. Distribution of ash-free dry mass (mg 0.1 $m^{-2}$) among taxonomic groups of the benthic macrofauna in the four infauna clusters.**

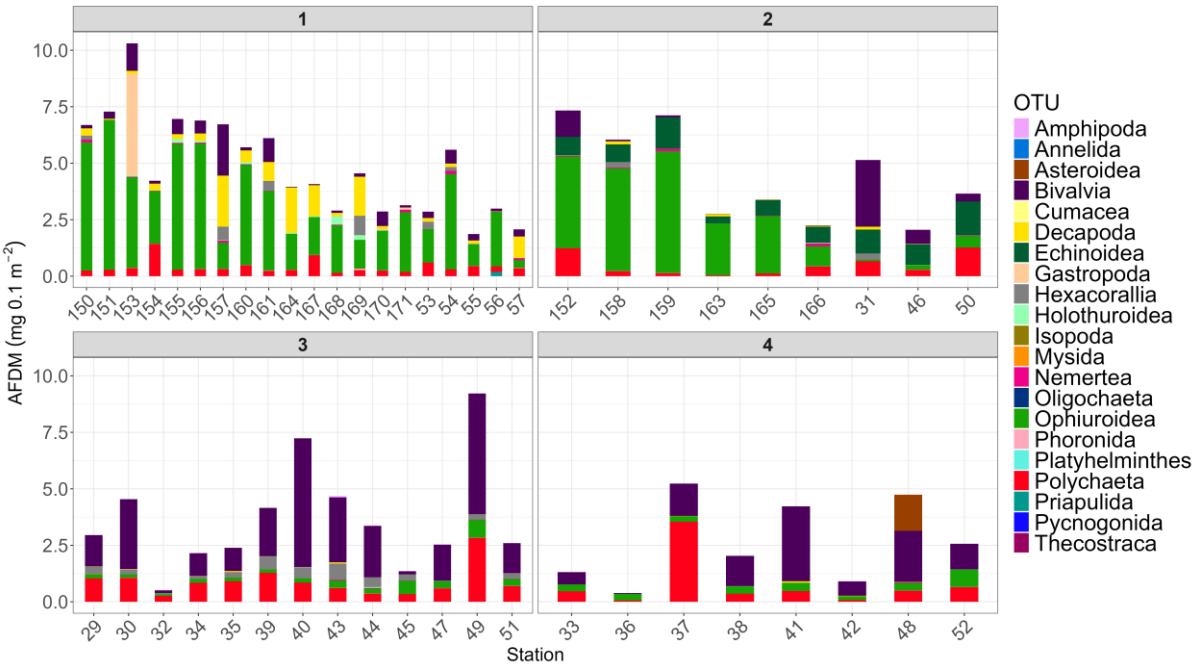


**Figure S2. Environmental variables at each station, with darker colors and larger symbols representing higher measured or modelled values.**

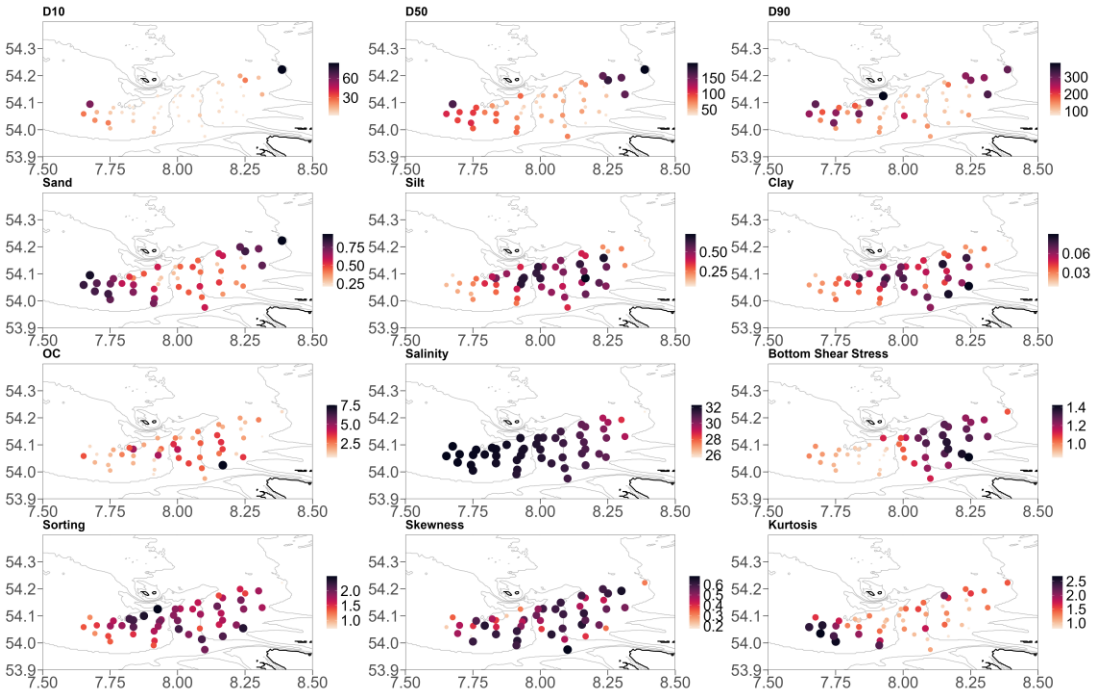

**Figure S3. Interaction plots displaying the variations of the relationships between diversity indices and ecosystem functions along environmental gradients. The moderator values correspond to the selected points along the environmental gradient: -1 S.D. (one standard deviation below the mean), Mean, and +1 S.D. (one standard deviation above the mean). Each plot is annotated and corresponded to the result in Table 3.**