Supplementary Material

## Supplementary Tables

**Supplementary Table 1.** Summary of granulometric properties of sediments (average ± standard deviation derived from 2 or 3 replicate samples per station). \*indicates values derived from only one replicate sample per station. MGS: mean grain size of the sortable silt fraction. Sediments were classified following the Shepard (1954) sediment classification scheme based on relative percentages of sand, silt, and clay.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Station** | **% gravel** | **% sand** | **% silt** | **% clay** | **MGS** μm | **Sediment class.** |
| WJBSh | 5.24 ± 5.24 | 22.06 ± 5.4 | 43.65 ± 7.59 | 29.06 ± 3.01 | 20.56 ± 0.61 | Clavey silt |
| OGCSl | 0.00 ± 0.00 | 72.21 ± 1.97 | 20.08 ± 1.23 | 7.70 ± 0.74 | 31.42 ± 0.28 | Silty sand |
| GC | 0.00\* | 75.63\* | 18.10\* | 6.28\* | 32.09\* | Sand |
| MNI-1 | 0.00\* | 24.08\* | 51.51\* | 24.41\* | 24.62\* | Sandy silt |
| FCoSl | 0.00 ± 0.00 | 44.64 ± 4.15 | 40.60 ± 3.30 | 14.76 ± 0.85 | 30.62 ± 1.20 | Silty sand |
| NHI-1 | 1.29 ± 1.84 | 73.81 ± 0.22 | 18.15 ± 1.17 | 6.75 ± 0.44 | 38.70 ± 0.43 | Silty sand |
| NHI-2 | 0.00\* | 72.30\* | 20.45\* | 7.25\* | 38.37\* | Silty sand |
| MNI-2 | 0.00 ± 0.00 | 77.13 ± 0.52 | 15.34 ± 0.28 | 7.53 ± 0.24 | 28.82 ± 0.40 | Sand |
| CC | 0.00 ± 0.00 | 50.43 ± 3.90 | 36.09 ± 2.45 | 13.49 ± 1.45 | 32.75 ± 1.26 | Silty sand |
| MNI-3 | 0.00\* | 53.26\* | 30.43\* | 16.3\* | 30.92\* | Silty sand |

**Supplementary Table 2.** Statistic results of ANOVA main tests for all benthic nutrient fluxes considered in our study. \*indicates significant p-values (< 0.05). df: degrees of freedom; F: F-statistic; p: p-value.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Nitrate flux** |  | |  | |  |  |  |  |
| **Source** | **Main test** | | **Sum of Squares** | | **df** | **Mean Square** | **F** | **p** |
| Depth | ANOVA type III (Tukey) | | 42212 | | 1 | 42212 | 0.177 | 0.678 |
| Habitat (depth) | 210797 | | 3 | 70266 | 0.295 | 0.828 |
| Res | 5234503 | | 22 | 237932 |  |  |
| **Nitrite flux** |  | |  | |  |  |  |  |
| **Source** | **Main test** | | **Sum of Squares** | | **df** | **Mean Square** | **F** | **p** |
| Depth | ANOVA type III (Tukey) | | 161 | | 1 | 160.62 | 0.648 | 0.429 |
| Habitat (depth) | 218 | | 3 | 72.68 | 0.293 | 0.83 |
| Res | 5454 | | 22 | 247.9 |  |  |
| **Ammonium flux** | |  | |  |  |  |  |  |
| **Source** | **Main test** | | **Sum of Squares** | | **df** | **Mean Square** | **F** | **p** |
| Depth | ANOVA type III (Tukey) | | 2808 | | 1 | 2808 | 0.076 | 0.7859 |
| Habitat (depth) | 301903 | | 3 | 100634 | 2.71 | 0.0697 |
| Res | 816839 | | 22 | 37129 |  |  |
| **Phosphate flux** |  | |  | |  |  |  |  |
| **Source** | **Main test** | | **Sum of Squares** | | **df** | **Mean Square** | **F** | **p** |
| Depth | ANOVA type III (Tukey) | | 247012 | | 1 | 247012 | 4.275 | 0.0506 |
| Habitat (depth) | 251192 | | 3 | 83731 | 1.449 | 0.2557 |
| Res | 1271225 | | 22 | 57783 |  |  |
| **Silicate flux** |  | |  | |  |  |  |  |
| **Source** | **Main test** | | **Sum of Squares** | | **df** | **Mean Square** | **F** | **p** |
| Depth | ANOVA type III (Tukey) | | 8313555 | | 1 | 8313555 | 2.506 | 0.12768 |
| Habitat (depth) | 49912070 | | 3 | 16637357 | 5.015 | 0.00845\* |
| Res | 72981769 | | 22 | 3317353 |  |  |

**Supplementary Table 3.** Statistic results of PERMANOVA main tests of benthic nutrient fluxes. \*indicates significant p-values (< 0.05). df: degrees of freedom; SS: sum of squares; MS: mean sum of squares; Pseudo-F: F value by permutation; p(perm): p-value based on 9999 random permutations; Unique perms: number of unique permutations.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Benthic nutrient fluxes** | | |  |  |  |  |
| **Source** | **df** | **SS** | **MS** | **Pseudo-F** | **p (perm)** | **Unique perms.** |
| Depth | 2 | 30470000 | 15235000 | 0.97979 | 0.5157 | 180 |
| Habitat (depth) | 3 | 50676000 | 16892000 | 4.7058 | 0.0055\* | 9947 |
| Res | 25 | 89741000 | 3589600 |  |  |  |

**Supplementary Table 4.** Statistic results of ANOVA main tests for all macrofaunal diversity indices considered in our study. \*indicates significant p-values (< 0.05). df: degrees of freedom; F: F-statistic; p: p-value.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Total macrofaunal density** | | |  |  |  |  |  |
| **Source** | **Main test** | | **Sum of Squares** | **df** | **Mean Square** | **F** | **p** |
| Depth | ANOVA type III (Tukey) | | 813140744 | 1 | 813140744 | 103.94 | <0.001\* |
| Habitat (depth) | 314160502 | 3 | 104720167 | 13.39 | <0.001\* |
| Res |  | | 179924702 | 23 | 7822813 |  |  |
| **Total number of taxa** | |  |  |  |  |  |  |
| **Source** | **Main test** | | **Sum of Squares** | **df** | **Mean Square** | **F** | **p** |
| Depth | ANOVA type III (Tukey) | | 74.3 | 1 | 74.3 | 9.371 | 0.0055\* |
| Habitat (depth) | 71.46 | 3 | 23.82 | 3.004 | 0.0512 |
| Res |  | | 182.35 | 23 | 7.93 |  |  |
| **Pielou's evenness (J')** | |  |  |  |  |  |  |
| **Source** | **Main test** | | **Sum of Squares** | **df** | **Mean Square** | **F** | **p** |
| Depth | ANOVA type III (Tukey) | | 0.01648 | 1 | 0.016475 | 13.14 | 0.0014\* |
| Habitat (depth) | 0.00726 | 3 | 0.00242 | 1.93 | 0.15296 |
| Res |  | | 0.02884 | 23 | 0.001254 |  |  |
| **Vertical distribution** |  | |  |  |  |  |  |
| **Source** | **Main test** | | **Sum of Squares** | **df** | **Mean Square** | **F** | **p** |
| Depth | ANOVA type III (Tukey) | | 0.00083 | 1 | 0.00083 | 0.466 | 0.5015 |
| Habitat (depth) | 0.02031 | 3 | 0.006769 | 3.802 | 0.0238\* |
| Res |  | | 0.04095 | 23 | 0.001781 |  |  |

**Supplementary Table 5.** Statistic results of PERMANOVA main tests of macrofaunal community composition. \*indicates significant p-values (< 0.05). df: degrees of freedom; SS: sum of squares; MS: mean sum of squares; Pseudo-F: F value by permutation; p(perm): p-value based on 9999 random permutations; Unique perms: number of unique permutations.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Macrofaunal community composition** | | | |  |  |  |
| **Source** | **df** | **SS** | **MS** | **Pseudo-F** | **p (perm)** | **Unique perms.** |
| Depth | 2 | 8127 | 4063.5 | 1.4749 | 0.1047 | 180 |
| Habitat (depth) | 3 | 8766.7 | 2922.2 | 2.1136 | 0.001\* | 9874 |
| Res | 26 | 35946 | 1382.6 |  |  |  |

**Supplementary Table 6**. Statistic results of PERMANOVA main tests of macrofaunal biological trait expression. \*indicates significant p-values (< 0.05). df: degrees of freedom; SS: sum of squares; MS: mean sum of squares; Pseudo-F: F value by permutation; p(perm): p-value based on 9999 random permutations; Unique perms: number of unique permutations.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Macrofaunal biological trait expression** | | | |  |  |  |
| **Source** | **df** | **SS** | **MS** | **Pseudo-F** | **p (perm)** | **Unique perms.** |
| Depth | 2 | 2200 | 1100 | 2.8484 | 0.1322 | 180 |
| Habitat (depth) | 3 | 1256.7 | 418.88 | 3.5575 | 0.0095\* | 9950 |
| Res | 26 | 3061.4 | 117.75 |  |  |  |

## 

## Supplementary Figures

Chart, scatter chart

Description automatically generated

**Supplementary Figure 1.** Redundancy analysis (dbRDA) from the best distance-based linear model (DistLM) of benthic nutrient fluxes and **a**) all environmental variables or **b**) all selected biological variables. Vectors show direction and strength of environmental variables (**a**) or density of macrofaunal taxa and polychaete families (**b**) contributing to variation in benthic nutrient fluxes. B [oxygen] refers to the bottom water concentration of oxygen.

Chart, scatter chart, bubble chart

Description automatically generated

**Supplementary Figure 2.** Redundancy analysis (dbRDA) from the best distance-based linear model (DistLM) of **a**) macrofaunal community composition and all environmental variables and **b**) macrofaunal biological trait expression and all environmental variables. Vectors show the direction and strength of environmental variables contributing to variation of macrofaunal community composition (**a**) and biological trait expression (**b**). TOM: total organic matter; Chl *a*: TOC: chlorophyll *a* to total organic carbon ratio.TN: total nitrogen; Phaeo: phaeopigments; Chl *a*: chlorophyll *a*.