**Supplementary material 4:**

**Catalogue of substrate categories. (1) = primary substrate (>50-100%), and (2) = secondary substrate (<50%).**

|  |  |
| --- | --- |
| **Soft (1)** |  |
| **Gravels (1)** |  |
| **Biogenic (1)** |  |
| **Soft (1) / Carbonate rock (2)** |  |
| **Soft (1) / Volcanic rock (2)** |  |
| **Mixed volcanic-sediment** |  |
| **Mixed carbonate-sediment** |  |
| **Volcanic rock (1)/ soft (2)** |  |
| **Carbonate rock (1)/ soft (2)** |  |
| **Volcanic rock (1)** |  |
| **Carbonate rock (1)** |  |
| **Mixed rock (volcanic, carbonate)** |  |
| **Mixed (volcanic, carbonate, soft)** |  |
| **Gravels (1) /carbonate (2)** |  |
| **Mixed biogenic/gravels**  *a few images with also <<50% of carbonate or volcanic rocks.* |  |
| **Carbonate rock (1) /biogenic (2)** |  |

**Calculation of substrate index per polygon:**

1. **Substrate frequency per polygon:**

From a presence/absence matrix of 9 substrate facies (columns) X images (rows), we summed for each substrate facies the number of images where the substrate facies is present / total number of images within the polygon.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Polygon | Image | Soft 100% | Volcanic rock  100% | Carbonate rock  100% | Gravels  100% | Biogenic  100% | Mixed rock | Mixed soft/carbonate | Mixed soft/volcanic | Mixed (volcanic, carbonate, soft) |
| P1 | Image 1 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Image 2 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Image 3 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

E.g.,

Substrate frequency for P1: Soft = 2/3 = ~0.66; Volcanic rock = 1/3 = ~0.33

1. **Substrate diversity per polygon:**

Apply of the Shannon diversity calculation from the substrate frequency per polygon. Use of the *diversity()* function, index = “shannon” (vegan package) with R. Based on the work applied in Clark et Bowden, 2015.

Clark, M.R., Bowden, D.A., 2015. Seamount biodiversity: high variability both within and between seamounts in the Ross Sea region of Antarctica. Hydrobiologia 761, 161–180. <https://doi.org/10.1007/s10750-015-2327-9>

1. **Hardness score per polygon:**
2. We applied a hardness score (in brackets) to each of the substrate facies in the following way, according to the semi-quantitative substrate coverage approximation from the 17 substrate facies:

-soft sediment (100%) **(1)**-gravels (100%) **(2)**- biogenic (100%) **(2)** (fine discontinuous substrate, similar in size to gravel)

- soft (>50%) + rock carbonate **(3)**-soft (>50%) + rock volcanic **(3**)   
-mixed volcanic/soft (50-50) **(4)**  
-mixed carbonate/soft (50-50) **(4)**-rock volcanic (>50%) + soft **(5)**   
-rock carbonate (>50%) + soft **(5**)   
-mixed (carbonate, volcanic, soft) **(5.5)**-gravels/carbonate **(5.5)**

-carbonate/biogenic **(5.5)**-biogenic/gravels/carbonate **(5.5)**

-biogenic/gravels/volcanic **(5.5)**  
- rock volcanic (100%) **(6)**- rock carbonate (100%) **(6)**-mixed rock (volcanic/carbonate) (50-50) **(6)**

1. We calculated the frequency of each substrate facies/polygon **🡪 see point 1) Substrate frequency per polygon.**
2. Next, we multiplied the hardness score \* substrate frequency for each facies = facies hardness score. Then, the sum of the hardness scores of each facies present in the polygon = polygon hardness index (globally, represents the level of hardness in the polygon according to its composition and ~substrate coverage/per image).