Supplementary Material

Restoration experiments in polymetallic nodule areas

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Appendix 1. Summary of the mineralogical composition and bulk powder X-ray diffractometry results of substrates. Substrates included dried (~20°C) and fired (>800°C) commercial and deep-seabed clay used for the production of artificial nodules, as well as natural nodules for control. X-ray diffractograms show values along the x-axis in degrees 2θ and values along the y-axis in counts per second (CPS). Artificial and natural nodules are very different in terms of composition: the artificial nodules produced in this study are dominated by silicates, whereas the deep-sea nodules are dominated by manganese and iron oxides.

| Substrate      | °C | Mineral content                                                                 |
|----------------|----|--------------------------------------------------------------------------------|
| Commercial clay| 20 | Illite/muscovite, kaolinite, quartz, K-feldspar, hematite, goethite, rutile (trace) |
| Deep-seabed clay| 20 | Quartz, hematite, zeolite (phillipsite), plagioclase (labradorite), clinopyroxene (augite-diopside), halite |
| Commercial clay| 1080 | Quartz, hematite, mullite, cristobalite (minor)                     |
| Deep-seabed clay| 800 | Quartz, hematite, plagioclase (labradorite), spinel, halite             |
| Deep-seabed clay| 1200 | Hematite, anorthoclase, spinel, cristobalite, quartz                   |
| Natural nodule | n.a. | 10 and 7 Å vermiculite, ferroxyhyte?, quartz, smectite (montmorillonite), zeolite (phillipsite) |
Appendix 2: Information on push-core samples taken after decompaction in an old epibenthic sledge track with a “decompaction rake” in the BGR/GER polymetallic nodule exploration area in the CCZ in 4127 meters water depth. Station number, date of sampling, ROV dive number (#), latitude, longitude, PUC core number, fixative, research purpose and comments are provided. F = Formaldehyde; env vars = environmental variables.

| Station number | Date Sampling | ROV Dive # | Latitude       | Longitude       | Core#  | Fixative | Research Purpose | Comment              |
|----------------|---------------|------------|----------------|-----------------|--------|----------|------------------|----------------------|
| SO268/2_188_1  | 12/5/2019     | 29         | 11° 51.617’ N  | 117° 00.747’ W  | PUC 20 | frozen   | env vars         | decompaction stretch 1 |
| SO268/2_188_1  | 12/5/2019     | 29         | 11° 51.617’ N  | 117° 00.747’ W  | PUC 7  | 4% F     | community         | decompaction stretch 1 |
| SO268/2_188_1  | 12/5/2019     | 29         | 11° 51.617’ N  | 117° 00.747’ W  | PUC 27 | 4% F     | community         | control 1             |
| SO268/2_188_1  | 12/5/2019     | 29         | 11° 51.617’ N  | 117° 00.747’ W  | PUC 71 | frozen   | env vars         | control 1             |
| SO268/2_188_1  | 12/5/2019     | 29         | 11° 51.617’ N  | 117° 00.747’ W  | PUC 11 | 4% F     | community         | decompaction stretch 2 |
| SO268/2_188_1  | 12/5/2019     | 29         | 11° 51.617’ N  | 117° 00.747’ W  | PUC 36 | frozen   | env vars         | decompaction stretch 2 |
| SO268/2_188_1  | 12/5/2019     | 29         | 11° 51.617’ N  | 117° 00.747’ W  | PUC 57 | frozen   | env vars         | control 2             |
| SO268/2_188_1  | 12/5/2019     | 29         | 11° 51.617’ N  | 117° 00.747’ W  | PUC 46 | frozen   | env vars         | decompaction stretch 3 |
| SO268/2_188_1  | 12/5/2019     | 29         | 11° 51.617’ N  | 117° 00.747’ W  | PUC 12 | 4% F     | community         | decompaction stretch 3 |
| SO268/2_188_1  | 12/5/2019     | 29         | 11° 51.617’ N  | 117° 00.747’ W  | PUC 17 | 4% F     | community         | control 3             |
| SO268/2_188_1  | 12/5/2019     | 29         | 11° 51.617’ N  | 117° 00.747’ W  | PUC 25 | frozen   | env vars         | control 3             |
Appendix 3: Overview of bar plots (average ± standard deviation) for all environmental variables (granulometry with median grain size, %sand, %silt, %clay; nutrients with total organic carbon (TOC), % total nitrogen (TN), C:N) between decompacted samples and control samples per sediment depth (0-1 cm, 1-2cm, 2-3cm, 3-4cm, 4-5cm).