Supplementary Material

Restoration experiments in polymetallic nodule areas

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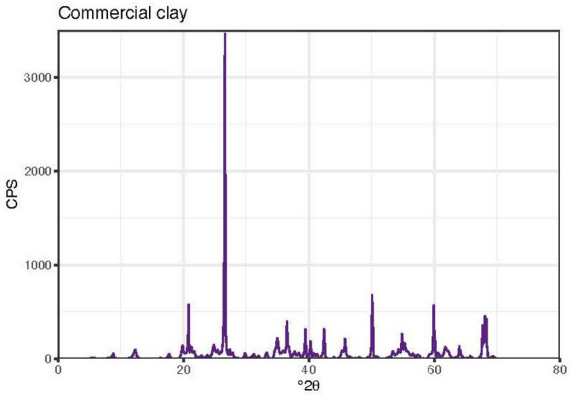
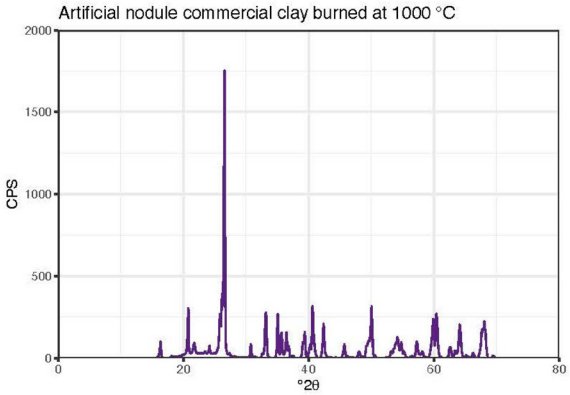
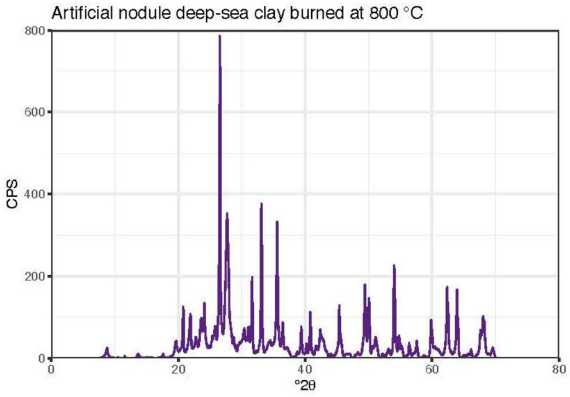
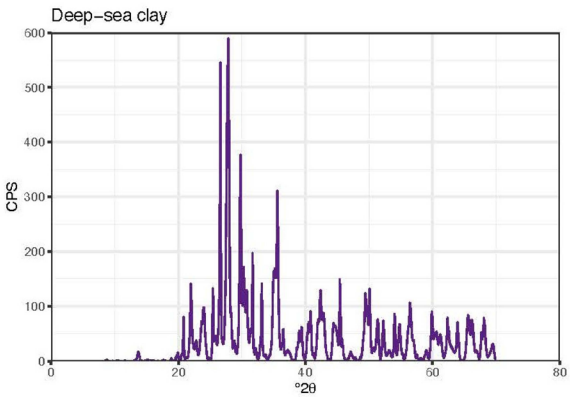
Appendix 1. Summary of the mineralogical composition and bulk powder X-ray diffractometry results of substrates. Substrates included dried (~20°C) and fired (>800°C) commercial and deep-seabed clay used for the production of artificial nodules, as well as natural nodules for control. X-ray diffractograms 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.

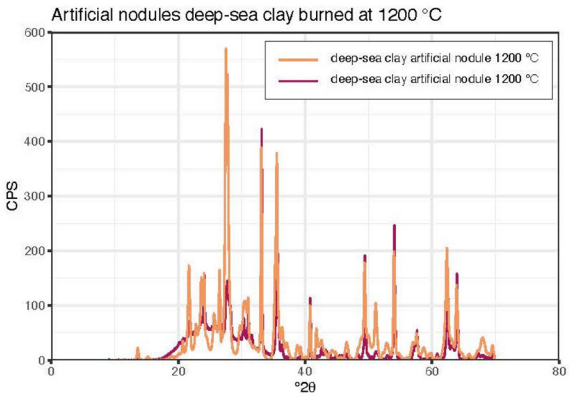
Substrate	°C	Mineral content
Commercial clay	20	Illite/muscovite, kaolinite, quartz, K feldspar, hematite, goethite, rutile (trace)
Deep-seabed clay	20	Quartz, hematite, zeolite (phillipsite), plagioclase (labradorite), clinopyroxene (augite-diopside), halite
Commercial clay	1080	Quartz, hematite, mullite, 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 vernadite, feroxyhyte?, quartz, smectite (montmorillonite), zeolite (phillipsite)

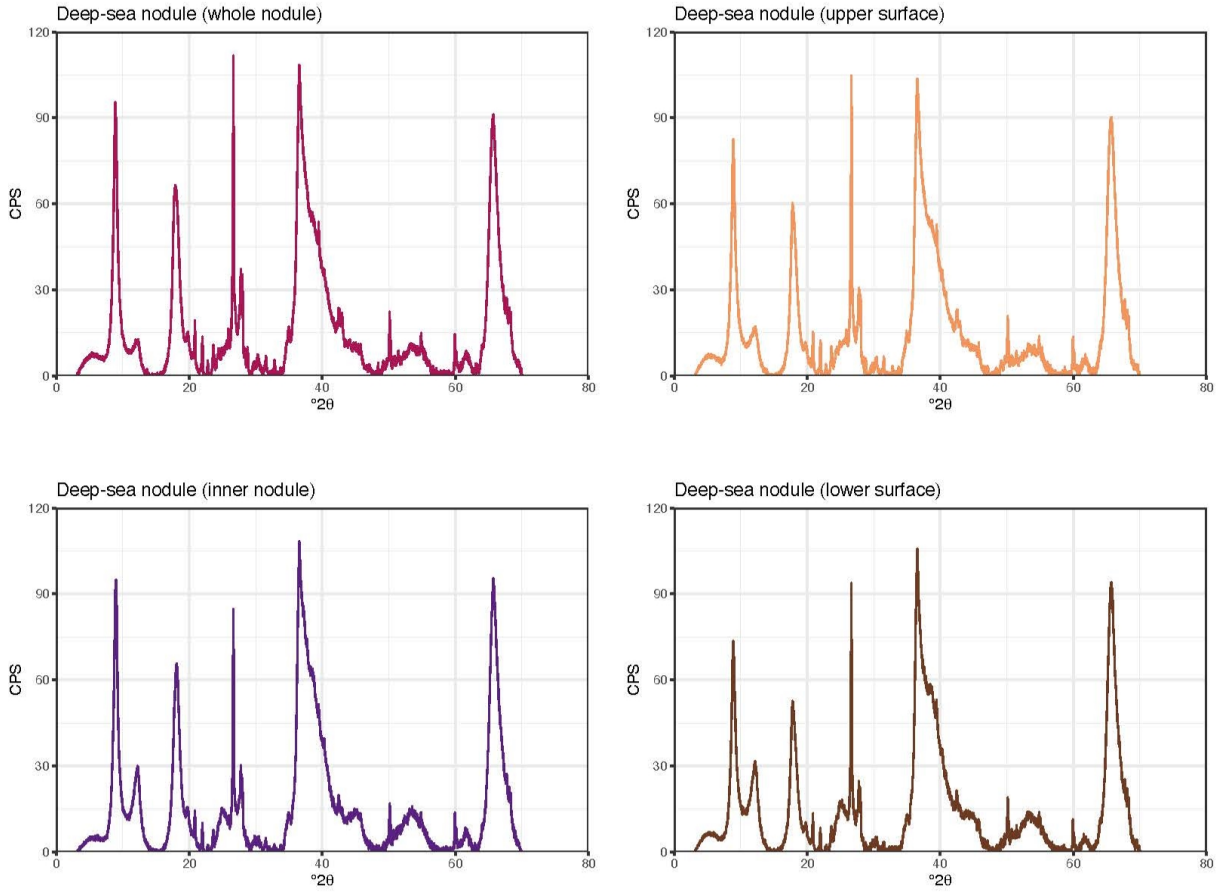












Appendix 2: Information on push-core samples taken after decompaction in an old epibenthic sledge track with a “decompaction rake” in the BGR/GER polymetallic nodule exploration area in the CCZ in 4127 meters water depth. Station number, date of sampling, ROV dive number (#), latitude, longitude, PUC 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 24	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 11	4% F	community	control 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).