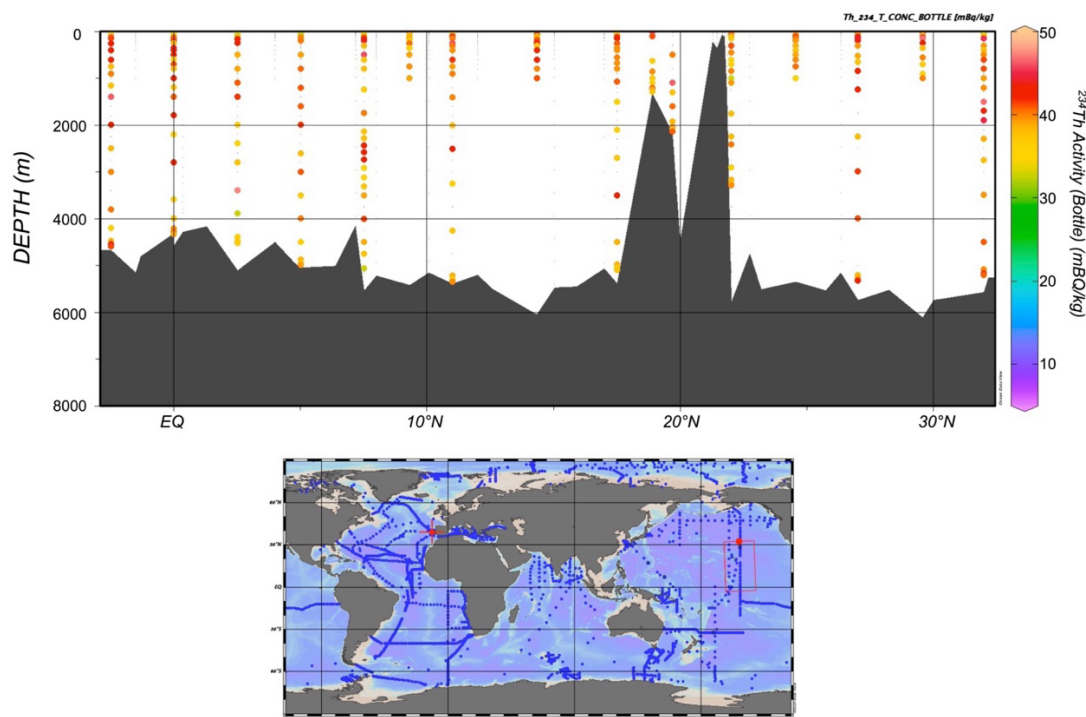


Supplementary Material

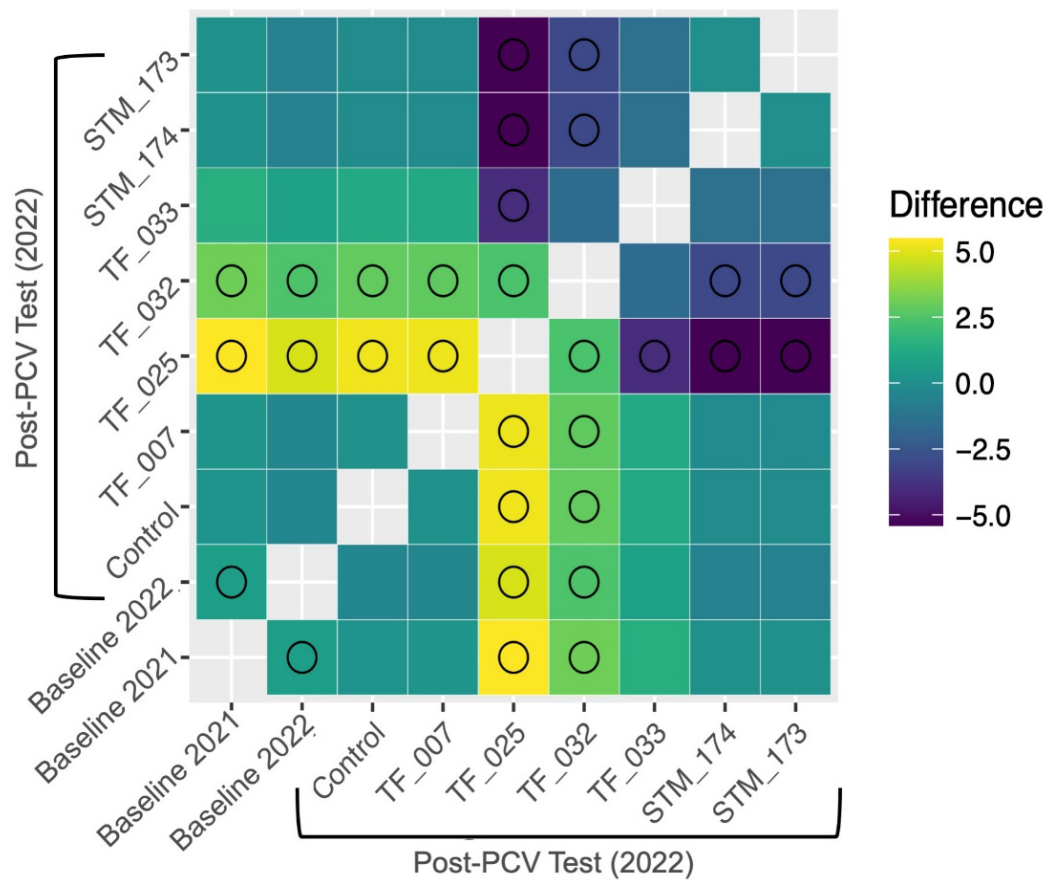
Supplementary Table S1: Summary of $^{234}\text{Th}_{\text{xs}}$ values in surface sediments (0–1 cm) by campaign and treatment.

Table shows the number of independent core samples analyzed (n), mean excess Thorium-234 activity ($^{234}\text{Th}_{\text{xs}}$ in dpm g^{-1}), and associated standard error (SE) for each sampling campaign and Treatment type/site. Baseline samples were collected in 2021 and 2022. Post-PCV test samples were collected in late 2022, with distances from the collector test site indicated where applicable. Control samples were collected ~7 km northwest of the test field and are considered unaffected reference conditions.

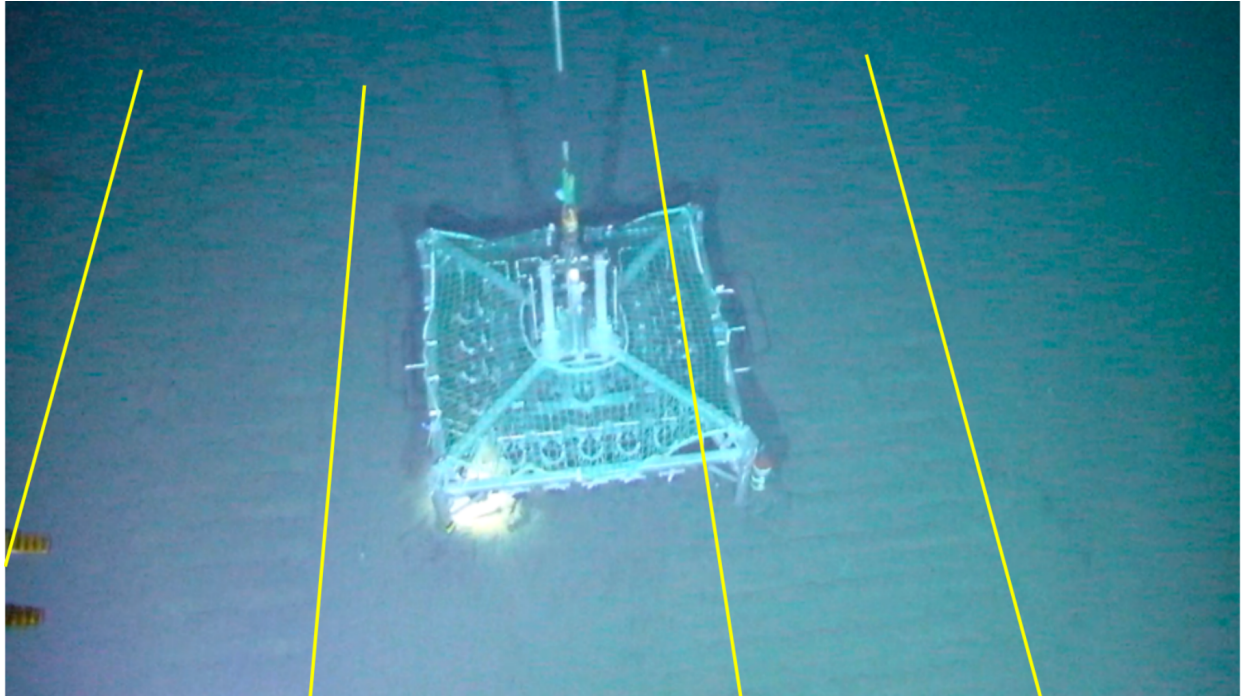
Campaign	Treatment Type	Cores analyzed (n=)	Mean $^{234}\text{Th}_{\text{xs}}$ (0-1 cm) (dpm g^{-1})	SE
2021 (5D)	Baseline	34	0.42	0.13
2022 (7A)	Baseline	26	1.07	0.15
2022 (7B2)	Post-PCV Test	24	2.03	0.45
	Control (7 km NW)	4	0.64	0.15
	TF_007 (Tracks)	6	0.69	0.22
	TF_032 (0.2 km NE)	2	3.5	0.4
	TF_025 (0.5 km NE)	5	5.88	0.14
	TF_033 (1 km NE)	1	1.86	-
	STM_174 (2 km NE)	3	0.49	0.14
	STM_173 (3 km NE)	3	0.49	0.17



Supplementary Fig. S1: Concentrations of ^{234}Th measured in the water column measured in mBQ/kg across the central Pacific Ocean. Each point represents an individual measurement from a water sample (Data collated from GEOTRACES¹).



Supplementary Fig. S2: Heatmap of Tukey's Honest Significant Difference (HSD) post hoc test results, comparing mean differences between baseline (2021, 2022) and Post-PCV Test (2022) treatments to assess significant effects. Circles denote statistically significant differences ($p < 0.05$), and color represents effect magnitude. $n = 34$ cores for 2021 baseline, $n = 26$ cores for 2022 baseline, and $n = 24$ cores for Post-PCV Test treatments; specific site-level sample sizes are detailed in Supplementary Table S1. Exact p -values for all pairwise comparisons are provided in "Supplementary Data 2.xlsx".



Supplementary Fig. S3: ROV still image showing the deployment of the Oktopus multicorer within the directly mined track during post-collector environmental monitoring. Yellow lines denote the caterpillar treads of the prototype collector vehicle, used to ensure accurate placement for sediment sampling within the disturbed area.

References

1. GEOTRACES Intermediate Data Product Group, Buessler, K.; Kenyon S; Pike, 2023. The GEOTRACES Intermediate Data Product 2021v2 (IDP2021v2). NERC EDS British Oceanographic Data Centre NOC. doi:10.5285/ff46f034-f47c-05f9-e053-6c86abc0dc7e.