



Supplement of

Revisiting five decades of ^{234}Th data: a comprehensive global oceanic compilation

Elena Ceballos-Romero et al.

Correspondence to: Elena Ceballos-Romero (eceballos1@us.es)

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Supplementary Material

Table S1. Fields (rows) in the “metadata” table.

FIELD NAME	FIELD TYPE	FIELD DESCRIPTION
Reference_USE	Integer	Unique integer record ID number (format 0000).
INFO	<i>Header</i>	<i>Header</i>
Project_Name	Text	Name of the project(s)/program(s) in which the sampling(s) cruise(s) was(were) involved (if applicable). If several cruises compiled, indicate individually. If none, -999.
Several_cruises	Number/Short text	YES/NO.
Cruise_ID	Number/Short text	Cruise(s) name or number(s) during which data compiled were collected. If several cruises compiled, indicate individually. If unknown, -999.
Leg_details	Number/Short text	Leg details of the sampling cruise(s) (if applicable). If several cruises compiled, report individually. If unknown, -999.
Ship	Short text	Research vessel(s) used for the sampling cruise(s). If several cruises compiled, indicate individually. If unknown, -999.
Chief_Scientist	Short text	Chief scientist(s) of the sampling cruise(s). If several cruises compiled, indicate individually. If unknown, -999.
Ocean	Short text	Sampling ocean. If unknown, -999.
Region	Short text	Sampling region. If sea sampled, indicate here. If unknown, -999.
Latitude_max_decimal_degrees	Number	Maximum north latitude in decimal degrees (from -90 to +90).
Latitude_min_decimal_degrees	Number	Minimum north latitude in decimal degrees (from -90 to +90).
Longitude_max_decimal_degrees	Number	Maximum east longitude in decimal degrees (from -180 to +180).
Longitude_min_decimal_degrees	Number	Minimum east longitude in decimal degrees (from -180 to +180).
Bottom_depth_max(m)	Number	Maximum bottom depth of the locations sampled. If unknown, -999.
Period	Date - Date	Dates interval between first and last ²³⁴ Th sampling (YYY-MM-DD format).
Start_Date	Date	Date of first ²³⁴ Th sampling (YYY-MM-DD format).
End_Date	Date	Date of last ²³⁴ Th sampling (YYY-MM-DD format).
bloom_stage	Short text	Bloom stage at the sampling moment. Options: pre-bloom, bloom, post-bloom, no bloom. If several cruises compiled, indicate individually. If unknown, -999.
DATA	<i>Header</i>	<i>Header</i>
Number_of_stations	Integer	Number of stations sample. If some station corresponds to a long-term, high-frequency observations at fixed locations in the open ocean, indicated as “time-series”. If some stations were reoccupied

²³⁸ U	Short text	during sampling, indicated as “reoccupied”. Total number of ²³⁸ U concentration compiled in the dataset. YES/NO.
Total_ ²³⁴ Th	Short text	
Number_of_datapoints_Total	Integer	Total number of total ²³⁴ Th concentration compiled in the dataset. YES/NO.
Dissolved_ ²³⁴ Th	Short text	
Number_of_datapoints_Dissolved	Integer	Total number of dissolved ²³⁴ Th concentration compiled in the dataset. YES/NO.
Particulate_ ²³⁴ Th	Short text	
Number_of_datapoints_Part particulate	Integer	Total number of particulate ²³⁴ Th concentration compiled in the dataset. Size class(es) for particulate ²³⁴ Th sampling. Maximum of two sizes reported (denoted as “small” and “large”, preferably 1-53 um and < 53 um). If more than 2 sizes available, indicate the extra sizes not complied. If unknown, -999. YES/NO.
Size_class	Short text	
POC: ²³⁴ Th_ratio	Short text	
Number_of_datapoints_POC: ²³⁴ Th	Integer	Total number of POC: ²³⁴ Th ratios values compiled in the dataset. YES/NO.
PON: ²³⁴ Th_ratio	Short text	
Number_of_datapoints_PON: ²³⁴ Th	Integer	Total number of PON: ²³⁴ Th ratios values compiled in the dataset. <i>Header</i>
METHODS	<i>Header</i>	
²³⁸ U_method	Text	Sampling method for the particulate ²³⁴ Th fraction. If unknown, -999.
Total_ ²³⁴ Th_method	Text	Sampling method for the total ²³⁴ Th fraction. If unknown, -999.
Dissolved_ ²³⁴ Th_method	Text	Sampling method for the dissolved ²³⁴ Th fraction. If unknown, -999.
Particulate_ ²³⁴ Th_method	Text	Sampling method for the particulate ²³⁴ Th fraction. If unknown, -999.
SS/NSS	Short text	Options: i) SS, ii) NSS or iii) both. If unknown, -999.
comments	Text	Additional comments of interest regarding the dataset compiled. If none, -NO.
ADDITIONAL_DATA	<i>Header</i>	<i>Header</i>
²³⁴ Th_underway	Short text	YES/NO.
sediment_traps	Short text	Sediment trap type (if yes)/NO.
²¹⁰ Pb- ²¹⁰ Po	Short text	YES/NO.
CHN	Short text	YES/NO.
additional	Text	Data type, e.g., POC: ²³⁴ Th ratios from sediment traps (if yes)/NO.
DATA_SOURCE	<i>Header</i>	<i>Header</i>
Publication	Short text	YES/NO.
First_author_paper/data	Short text	Options: i) first author of the paper (if data reported are published in refereed journals), ii) first author of the data (if data reported are published in repositories), iii) data owner (if data reported are unpublished).

Journal	Short text	Options: i) journal of publication (if data reported are published in refereed journals), ii) -999 (if data reported are published in repositories), iii) “np” (if data reported are published in repositories or unpublished).
Year	Integer	Options: i) year of publication (if data reported are published in refereed journals or repositories), ii) -999 (if data reported are unpublished).
DOI/others	Short text	Options: i) Digital Object Identifier (DOI) of the publication or repository, if assigned, or ii) link of the data repository if data do not have a DOI associated. Otherwise, -999.
data_localization	Short text	Details of the localization of the data. Options: i) number of table(s), and/or ii) figure(s), and/or iii) link to repository, and/or iv) personal communication from author (if so, specify author name). If none, -999.
data_resource	Short text	Options: i) link to access the data (either publication or repository URL if data reported are published), sometimes this link is the same that the DOI/others link and ii) “personal communication from <i>Author Name</i> ” (if data reported are unpublished). In case of a PhD thesis, the name of the thesis and University is added.
Other DOI/resources	Short text	Alternative useful information or additional links. If data compiled are also reported in another publication in refereed journals, indicate here (first author, year and DOI). If none, -999.

Table S2. Fields (columns) in the “data” table.

Field name	Field type	Field description
Cruise ID	Number/Short text	Cruise name or number. If none, -999.
station_ID	Number/Short text	Station name or number. If none, -999.
lat_decimal_degrees	Number	North latitude in decimal degrees (from - 90 to +90). If unknown, -999.
lon_decimal_degrees	Number	East longitude in decimal degrees (from -180 to +180). If unknown, -999.
month	Integer	Month of sampling. If unknown, -999.
day	Integer	Day of sampling. If unknown, -999.
year	Integer	Year of sampling. If unknown, -999.
DOY	Integer	Day Of Year (DOY). If unknown, -999.
bottom_depth(m)	Number	Station bottom depth (in m). If unknown, -999.
depth(m)	Number	Sampling depth for ²³⁴ Th total and dissolved concentrations (in m). If sample single vertically integrated over a depth interval, -555.
integrated_depth(m)	Number	Interval depth for ²³⁴ Th total and dissolved concentrations obtained as single vertically integrated samples (in m). If unknown, -999.
temperature	Number	Temperature at the sampling depth (in °C). If unknown, -999.
salinity	Number	Salinity at the sampling depth (in PSU). If unknown, -999.
²³⁸ U(dpm/L)	Number	²³⁸ U concentration at the sampling depth (in dpm/L). If unknown, -999.
uncert_ ²³⁸ U	Number	²³⁸ U concentration uncertainty at the sampling depth (in dpm/L). If unknown, -999.
total_ ²³⁴ Th(dpm/L)	Number	²³⁴ Th total concentration at the sampling depth (in dpm/L). If unknown, -999.
uncert_total ²³⁴ Th	Number	²³⁴ Th total concentration uncertainty at the sampling depth (in dpm/L). If unknown, -999.
diss_ ²³⁴ Th(dpm/L)	Number	²³⁴ Th dissolved concentration at the sampling depth (in dpm/L). If unknown, -999.
uncert_diss ²³⁴ Th	Number	²³⁴ Th dissolved concentration uncertainty at the sampling depth (in dpm/L). If unknown, -999.
method_1	Short text	Filtration sampling method for particulate ²³⁴ Th concentration. Options: i) Go-Flo bottle, ii) Niskin bottle, iii) filter, and iv) pump.
Depth_real_particle(m)	Number	Sampling depth for ²³⁴ Th particulate concentration with “method 1” (in m). If unknown, -999. If sample single vertically integrated over a depth interval, -555.
integrated_depth_real_particle(m)	Number	Interval depth for ²³⁴ Th particulate concentrations obtained as single vertically integrated samples with “method 1” (in m). If unknown, -999.
filter_size_small(um)	Short text	Filter size for the small fraction (preferably >1-53 μm) (in μm).
part_ ²³⁴ Th_small(dpm/L)	Number	²³⁴ Th particulate concentration at the sampling depth for the small size fraction (preferably >1-53 μm) measured with “method 1” (in dpm/L).
uncert_part ²³⁴ Th_small	Number	²³⁴ Th particulate concentration uncertainty at the sampling depth for the small size fraction (preferably >1-53 μm) measured with “method 1” (in dpm/L).
POC_small(umol/L)	Number	Particulate Organic Carbon (POC) concentration at the sampling depth for the small size fraction

uncert_POC_small	Number	(preferably >1-53 μm) measured with “method 1” (in $\mu\text{mol/L}$).
POC/Th_small(umol/dpm)	Number	Particulate Organic Carbon (POC) concentration uncertainty at the sampling depth for the small size fraction (preferably >1-53 μm) measured with “method 1” (in $\mu\text{mol/L}$).
uncert_POC/Th_small	Number	POC to particulate ^{234}Th ratio at the sampling depth for the small size fraction (preferably >1-53 μm) measured with “method 1” (in $\mu\text{mol/dpm}$).
PON_small(umol/L)	Number	POC to particulate ^{234}Th ratio uncertainty at the sampling depth for the small size fraction (preferably >1-53 μm) measured with “method 1” (in $\mu\text{mol/dpm}$).
uncert_PON_small	Number	Particulate Organic Nitrogen (PON) concentration at the sampling depth for the small size fraction (preferably >1-53 μm) measured with “method 1” (in $\mu\text{mol/L}$).
PON/Th_small(umol/dpm)	Number	Particulate Organic Nitrogen (PON) concentration uncertainty at the sampling depth for the small size fraction (preferably >1-53 μm) measured with “method 1” (in $\mu\text{mol/L}$).
uncert_PON/Th_small	Number	PON to particulate ^{234}Th ratio at the sampling depth for the small size fraction (preferably >1-53 μm) measured with “method 1” (in $\mu\text{mol/dpm}$).
filter_size_large(um)	Short text	PON to particulate ^{234}Th ratio uncertainty at the sampling depth for the small size fraction (preferably >1-53 μm) measured with “method 1” (in $\mu\text{mol/dpm}$).
part_ ^{234}Th _large(dpm/L)	Number	Filter size for the small fraction (preferably >53 μm) (in μm).
uncert_part ^{234}Th _large	Number	^{234}Th particulate concentration at the sampling depth for the large size fraction (preferably >53 μm) measured with “method 1” (in dpm/L).
POC_large(umol/L)	Number	^{234}Th particulate concentration uncertainty at the sampling depth for the large size fraction (preferably >53 μm) measured with “method 1” (in dpm/L).
uncert_POC_large	Number	Particulate Organic Carbon (POC) concentration at the sampling depth for the large size fraction (preferably >53 μm) measured with “method 1” (in $\mu\text{mol/L}$).
POC/Th_large(umol/dpm)	Number	Particulate Organic Carbon (POC) concentration uncertainty at the sampling depth for the large size fraction (preferably >53 μm) measured with “method 1” (in $\mu\text{mol/L}$).
uncert_POC/Th_large	Number	POC to particulate ^{234}Th ratio at the sampling depth for the large size fraction (preferably >53 μm) measured with “method 1” (in $\mu\text{mol/dpm}$).
PON_large(umol/L)	Number	POC to particulate ^{234}Th ratio uncertainty at the sampling depth for the large size fraction (preferably >53 μm) measured with “method 1” (in $\mu\text{mol/dpm}$).
uncert_PON_large	Number	Particulate Organic Nitrogen (PON) concentration at the sampling depth for the large size fraction (preferably >53 μm) measured with “method 1” (in $\mu\text{mol/L}$).
		Particulate Organic Nitrogen (PON) concentration uncertainty at the sampling depth for the large size fraction (preferably >53 μm) measured with “method 1” (in $\mu\text{mol/L}$).

PON/Th_large(umol/dpm)	Number	PON to particulate ²³⁴ Th ratio at the sampling depth for the large size fraction (preferably >1-53 μm) measured with “method 1” (in μmol/dpm).
uncert_PON/Th_large	Short text	PON to particulate ²³⁴ Th ratio uncertainty at the sampling depth for the large size fraction (preferably >53 μm) measured with “method 1” (in μmol/dpm).
method_2	Number	Sediment traps
Depth_real_particle_trap(m)	Number	Sampling depth for ²³⁴ Th particulate concentration with sediment traps (in m). If unknown, -999. If sample single vertically integrated over a depth interval, -555.
integrated_depth_real_particle_trap(m)	Number	Interval depth for ²³⁴ Th particulate concentrations obtained as single vertically integrated samples with sediment traps (in m). If unknown, -999.
POC/Th_trap(umol/dpm)	Number	POC to particulate ²³⁴ Th ratio at the sampling depth for the large size fraction (preferably >53 μm) measured with sediment traps (in μmol/dpm).
uncert_POC/Th_trap	Number	POC to particulate ²³⁴ Th ratio uncertainty at the sampling depth for the large size fraction (preferably >53 μm) measured with sediment traps (in μmol/dpm).
PON/Th_trap(umol/dpm)	Number	PON to particulate ²³⁴ Th ratio at the sampling depth for the large size fraction (preferably >53 μm) measured with sediment traps (in μmol/dpm).
uncert_PON/Th_trap	Number	PON to particulate ²³⁴ Th ratio uncertainty at the sampling depth for the large size fraction (preferably >53 μm) measured with sediment traps (in μmol/dpm).

Table S3. Summary of the ocean projects and experiments carried out during Era 3 in chronological order.

#	Project name	Acronym	Dates	Location
1	High-resolution temporal and spatial study of the Benthic biology and Geochemistry of a north-eastern Atlantic abyssal Locality	BENGAL	1996-1999	Time-series station BENGAL (49.83°N, 16.58°W) (Atlantic Ocean)
2	Mediterranean Targeted Project II-Mass Transfer and Ecosystem Response	MTP II-MATER	March-May 1997	Gulf of Lions (Atlantic Ocean)
3	Biogeochemical Transport of Matter and Energy in the Deep Sea	BIGSET	1997-1998	Arabian Sea
4	EC ARMARA Project	ARMARA	1998	Atlantic Ocean
5	Arctic Light and Heat	ALV	1999	Arctic Ocean
6	Biogeochemical Transport of Matter and Energy in the Deep Sea	BIGSET	2000	PAP Site (Atlantic Ocean)
7	European Iron Enrichment Experiment in the Southern Ocean	EisenEx*	2000	Southern Ocean
8	CARbon Transfer, Transport and Transformation	CAR-TTT	2000	South China Sea
9	Subarctic Pacific Iron Experiment for Ecosystem Dynamics Study	SEEDS*	2001-2004	Arctic Ocean
10	Southern Ocean Iron Experiment	SOFeX*	2002	south of New Zealand (Southern Ocean)
11	Second Chinese Arctic Expedition	-	2003	Arctic Ocean
12	Carbon flux and ecosystem feedback in the northern Barents Sea in an era of climate change	CABANERA	2003	Barents Sea (Atlantic Ocean)
13	Canadian Arctic Shelf Exchange Study	CASES	2003	Arctic Ocean
14	Production and Export of Carbon: control by Heterotrophs at short time scale	PECHE	April 2003-Oct 2004	Mediterranean Sea (Atlantic Ocean)
15	VERTical Transport In the Global Ocean	VERTIGO	2003-2007	ALOHA station & a new moored time-series site in the subarctic NW Pacific (Japanese site K2; 47°N 160°E) site (Pacific Ocean)
16	CROZet natural iron bloom and EXPORT experiment	CROZEX	Dec 2004-Jan 2005	Southern Indian Ocean and the Southern Ocean in the region of the Crozet Plateau
17	Eddies Dynamics, Mixing, Export, and Species composition	EDDIES	2004-2005	Sargasso Sea (Atlantic Ocean)
18	Kerguelen Ocean and Plateau compared Study	KEOPS	Jan-Feb 2005	Southern Ocean
19	Blue Water Zone project	BWZ	2005-2008	Drake Passage (Southern Ocean)
20	Plankton Community Structure and Iron Distribution	-	2006	Drake Passage (Southern Ocean)

*compiled in the FeSynth initiative (see Section 4.2)

Figure S1 Annual (a) and seasonal (b) distribution of field surveys including ^{234}Th sampling since the first reported sampling in 1967 separated by Northern and Southern Hemisphere (NH and SH respectively). Dotted lines indicate tipping points in the ^{234}Th timeline.

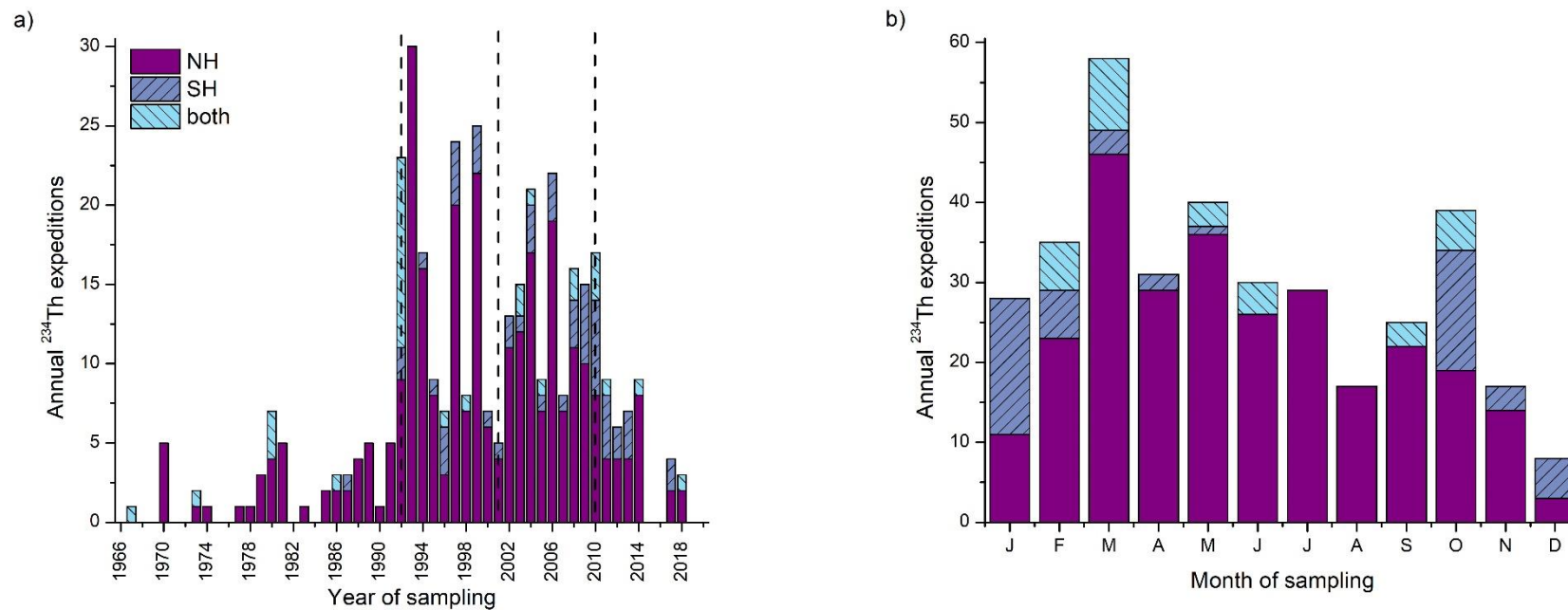


Figure S2 Time distribution of annual ^{234}Th publications (either in referred journals or repositories) since the first reported publication in 1969 separated by ocean as follows: i) Atlantic, ii) Arctic, iii) Indian, iv) Pacific and v) Southern, with and additional category for vi) Others, which includes rivers, lakes and bays. Dotted lines indicate tipping points in the ^{234}Th timeline.

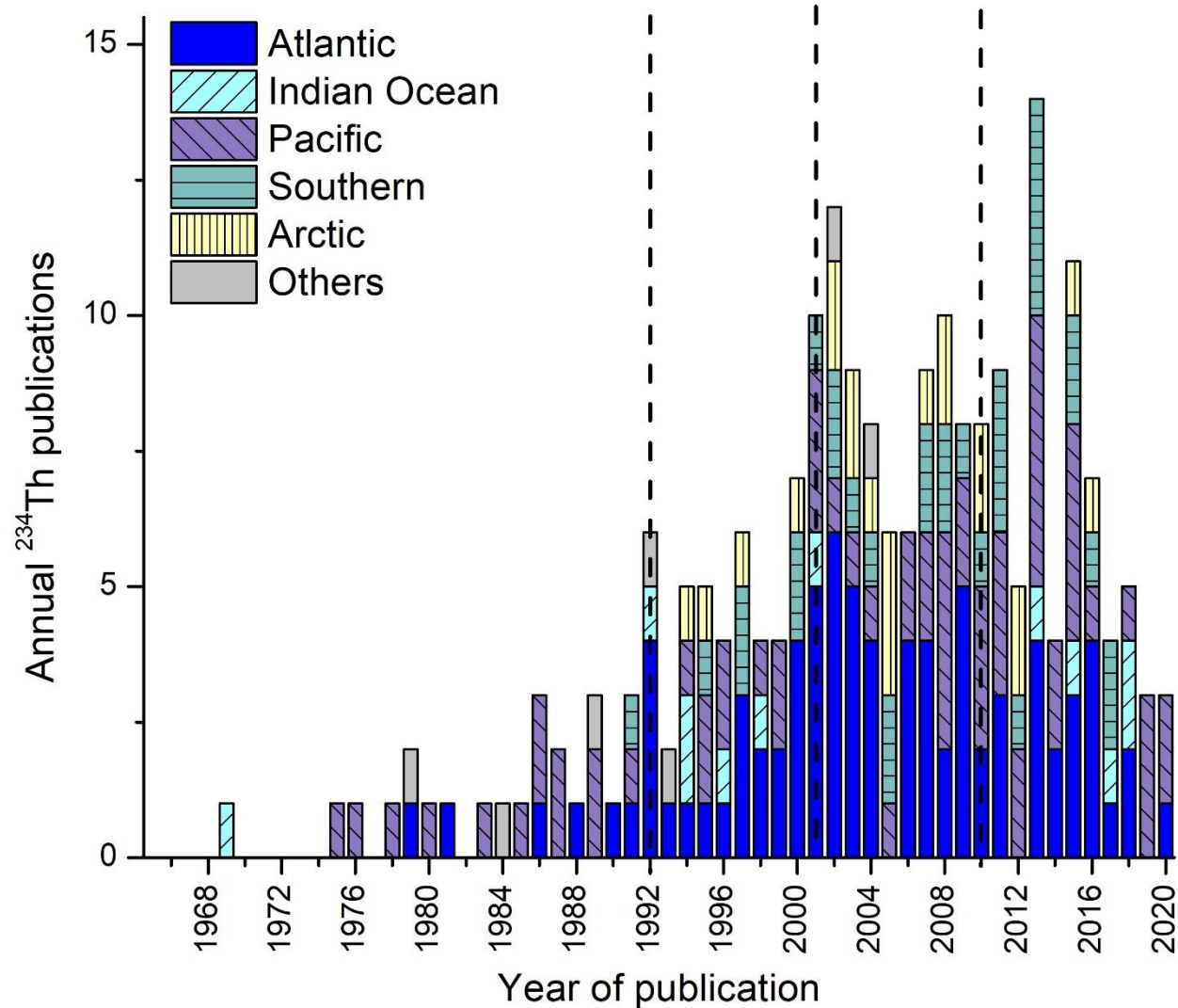


Figure S3 General view of the ^{234}Th particulate data compiled sampled on either i) small, generally from 0.7-1 to 53-70 μm (yellow diamonds) ii) large, >53 or >70 μm (dark blue squares) or iii) both size fractions (magenta dots).

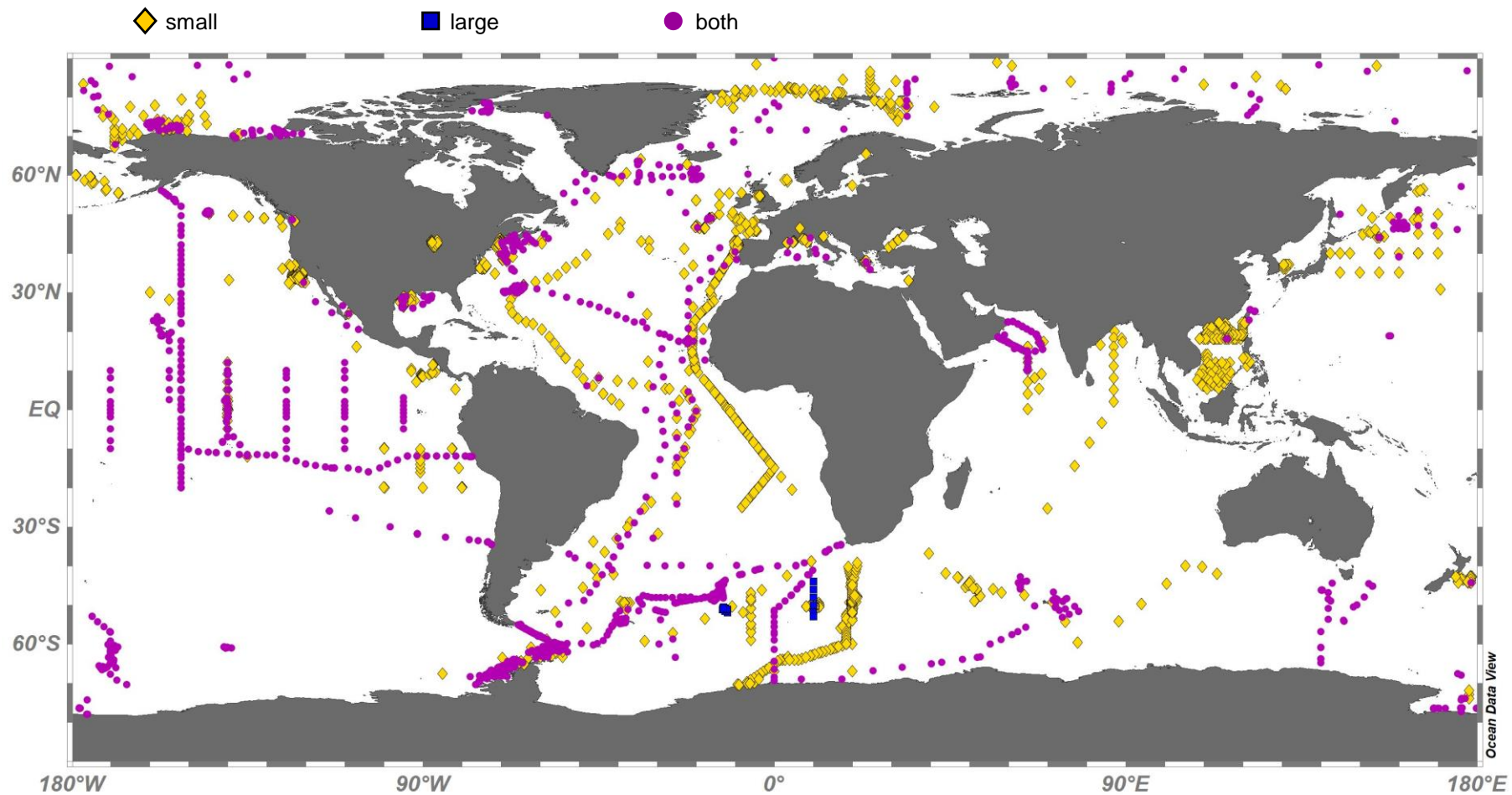


Figure S4 Overview of POC:²³⁴Th data compiled by sampling method according to i) filtration methods: i.e., bottles (Go-Flo and Niskin types), in-situ filtration systems (e.g., MULVFS), SPLITT (split flow-thin cell fractionation), and (large or small volume) in-situ pumps among the most common ones (yellow diamonds), ii) sediment traps (dark blue squares), or iii) both a filtration method and sediment traps (magenta dots).

