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*Supplement of*

## **Carbon export in the naturally iron-fertilized Kerguelen area of the Southern Ocean based on the $^{234}\text{Th}$ approach**

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Table S1.  $^{238}\text{U}$  and  $^{234}\text{Th}$  activities ( $\text{dpm L}^{-1}$ ), and associated  $^{234}\text{Th}$  to  $^{238}\text{U}$  ratio measured during KEOPS2 expedition

CTD #	Station #	Lon °E	Lat °S	depth (m)	Salinity (psu)	$^{238}\text{U}$ ( $\text{dpm L}^{-1}$ )	$^{234}\text{Th}$ ( $\text{dpm L}^{-1}$ )	$^{234}\text{Th}/^{238}\text{U}$
4	A3-1	72.08	-50.629	20	33.897	2.35	2.16	0.92
4	A3-1	72.08	-50.629	40	33.899	2.35	2.13	0.91
4	A3-1	72.08	-50.629	60	33.905	2.35	2.15	0.91
4	A3-1	72.08	-50.63	80	33.917	2.35	2.22	0.95
4	A3-1	72.08	-50.629	100	33.936	2.35	2.24	0.95
4	A3-1	72.08	-50.63	125	34.018	2.36	2.23	0.95
4	A3-1	72.08	-50.629	150	34.063	2.36	2.29	0.97
4	A3-1	72.08	-50.63	200	34.103	2.37	2.29	0.97
4	A3-1	72.08	-50.629	275	34.145	2.37	2.30	0.97
4	A3-1	72.08	-50.63	350	34.261	2.38	2.26	0.95
4	A3-1	72.08	-50.629	450	34.362	2.39	1.80	0.75
8	TNS-8	72.24	-49.463	10	33.868	2.35	1.99	0.85
8	TNS-8	72.24	-49.463	40	33.868	2.35	1.98	0.85
8	TNS-8	72.24	-49.463	100	33.872	2.35	2.10	0.89
8	TNS-8	72.24	-49.463	150	33.88	2.35	2.17	0.93
8	TNS-8	72.24	-49.463	200	33.916	2.35	2.35	1.00
8	TNS-8	72.24	-49.463	250	34.103	2.37	2.37	1.00
8	TNS-8	72.24	-49.463	300	34.245	2.38	2.34	0.99
8	TNS-8	72.24	-49.463	400	34.377	2.39	2.37	0.99
8	TNS-8	72.24	-49.463	500	34.469	2.39	2.41	1.01
8	TNS-8	72.24	-49.463	600	34.532	2.40	2.37	0.99
8	TNS-8	72.24	-49.463	700	34.568	2.40	2.40	1.00
8	TNS-8	72.24	-49.463	900	34.645	2.41	2.39	0.99
8	TNS-8	72.24	-49.463	1000	34.663	2.41	2.41	1.00
10	TNS-6	72.277	-48.779	35	33.845	2.35	2.06	0.88
10	TNS-6	72.277	-48.779	40	33.846	2.35	2.08	0.89
10	TNS-6	72.277	-48.779	100	33.854	2.35	2.07	0.88
10	TNS-6	72.277	-48.779	180	34	2.36	2.21	0.94
10	TNS-6	72.277	-48.779	200	34.036	2.36	2.33	0.99
10	TNS-6	72.277	-48.779	250	34.119	2.37	2.35	0.99
10	TNS-6	72.277	-48.779	300	34.248	2.38	2.35	0.99
10	TNS-6	72.277	-48.779	400	34.348	2.38	2.35	0.99
10	TNS-6	72.277	-48.779	500	34.473	2.39	2.36	0.98
10	TNS-6	72.277	-48.779	600	34.525	2.40	2.38	0.99
10	TNS-6	72.277	-48.779	800	34.63	2.41	2.38	0.99
10	TNS-6	72.277	-48.779	1500	34.743	2.42	2.42	1.00
10	TNS-6	72.277	-48.779	1800	34.745	2.42	2.39	0.99
15	TNS-1	71.501	-46.833	15	33.715	2.33	2.07	0.89
15	TNS-1	71.501	-46.833	40	33.715	2.33	2.06	0.88
15	TNS-1	71.501	-46.833	100	33.72	2.34	2.28	0.98
15	TNS-1	71.501	-46.833	180	33.782	2.34	2.40	1.02
15	TNS-1	71.501	-46.833	200	33.896	2.35	2.39	1.02

15	TNS-1	71.501	-46.833	250	33.992	2.36	2.37	1.01
15	TNS-1	71.501	-46.833	300	34.063	2.36	2.36	1.00
15	TNS-1	71.501	-46.833	400	34.212	2.37	2.38	1.00
15	TNS-1	71.501	-46.833	500	34.311	2.38	2.39	1.00
15	TNS-1	71.501	-46.833	600	34.433	2.39	2.41	1.01
15	TNS-1	71.501	-46.833	800	34.55	2.40	2.40	1.00
15	TNS-1	71.501	-46.833	1500	34.752	2.42	2.41	1.00
15	TNS-1	71.501	-46.833	2200	34.746	2.42	2.42	1.00
17	R-2	66.717	-50.359	20	33.772	2.34	2.07	0.88
17	R-2	66.717	-50.359	40	33.773	2.34	2.22	0.95
17	R-2	66.717	-50.359	80	33.772	2.34	2.27	0.97
17	R-2	66.717	-50.359	100	33.773	2.34	2.29	0.98
17	R-2	66.717	-50.359	125	33.778	2.34	2.31	0.99
17	R-2	66.717	-50.359	150	33.797	2.34	2.33	0.99
17	R-2	66.717	-50.359	200	33.899	2.35	2.36	1.00
17	R-2	66.717	-50.359	250	34.019	2.36	2.33	0.99
17	R-2	66.717	-50.359	300	34.095	2.36	2.35	0.99
17	R-2	66.717	-50.359	400	34.253	2.38	2.40	1.01
17	R-2	66.717	-50.359	500	34.348	2.38	2.39	1.00
17	R-2	66.717	-50.359	600	34.442	2.39	2.42	1.01
17	R-2	66.717	-50.359	700	34.519	2.40	2.37	0.99
17	R-2	66.717	-50.359	900	34.62	2.41	2.41	1.00
27	E-1	72.187	-48.458	20	33.852	2.35	1.94	0.83
27	E-1	72.187	-48.458	40	33.853	2.35	1.96	0.83
27	E-1	72.187	-48.458	80	33.857	2.35	2.00	0.85
27	E-1	72.187	-48.458	100	33.867	2.35	2.00	0.85
27	E-1	72.187	-48.458	125	33.876	2.35	2.05	0.87
27	E-1	72.187	-48.458	150	33.882	2.35	2.18	0.93
27	E-1	72.187	-48.458	200	33.96	2.35	2.30	0.98
27	E-1	72.187	-48.458	250	34.149	2.37	2.34	0.99
27	E-1	72.187	-48.458	300	34.243	2.38	2.35	0.99
27	E-1	72.187	-48.458	400	34.387	2.39	2.38	1.00
27	E-1	72.187	-48.458	500	34.468	2.39	2.39	1.00
27	E-1	72.187	-48.458	600	34.521	2.40	2.36	0.98
27	E-1	72.187	-48.458	700	34.573	2.40	2.40	1.00
27	E-1	72.187	-48.458	900	34.647	2.41	2.38	0.99
43	E-2	72.077	-48.523	10	33.855	2.35	2.09	0.89
43	E-2	72.077	-48.523	40	33.85	2.35	2.11	0.90
43	E-2	72.077	-48.523	100	33.881	2.35	2.14	0.91
43	E-2	72.077	-48.523	150	33.9	2.35	2.20	0.94
43	E-2	72.077	-48.523	200	34.008	2.36	2.27	0.96
43	E-2	72.077	-48.523	250	34.183	2.37	2.36	1.00
43	E-2	72.077	-48.523	300	34.284	2.38	2.35	0.99
43	E-2	72.077	-48.523	400	34.401	2.39	2.38	1.00
43	E-2	72.077	-48.523	500	34.479	2.40	2.39	1.00
43	E-2	72.077	-48.523	600	34.525	2.40	2.39	1.00

43	E-2	72.077	-48.523	800	34.616	2.41	2.38	0.99
43	E-2	72.077	-48.523	1000	34.676	2.41	2.40	1.00
43	E-2	72.077	-48.523	2020	34.744	2.42	2.40	0.99
47	TEW-8	74.999	-48.473	10	33.768	2.34	1.92	0.82
47	TEW-8	74.999	-48.473	40	33.786	2.34	2.00	0.85
47	TEW-8	74.999	-48.473	100	33.846	2.35	2.18	0.93
47	TEW-8	74.999	-48.473	150	33.883	2.35	2.28	0.97
47	TEW-8	74.999	-48.473	200	33.949	2.35	2.31	0.98
47	TEW-8	74.999	-48.473	250	34.023	2.36	2.32	0.99
47	TEW-8	74.999	-48.473	300	34.078	2.36	2.31	0.98
47	TEW-8	74.999	-48.473	400	34.278	2.38	2.35	0.99
47	TEW-8	74.999	-48.472	500	34.365	2.39	2.33	0.98
47	TEW-8	74.999	-48.472	600	34.452	2.39	2.39	1.00
47	TEW-8	74.999	-48.472	800	34.596	2.40	2.37	0.99
47	TEW-8	74.999	-48.472	1000	34.669	2.41	2.44	1.01
47	TEW-8	74.999	-48.471	2780	34.699	2.41	2.41	1.00
50	E-3	71.967	-48.702	20	33.844	2.35	1.87	0.80
50	E-3	71.967	-48.702	40	33.847	2.35	1.87	0.80
50	E-3	71.967	-48.702	80	33.854	2.35	1.90	0.81
50	E-3	71.967	-48.702	100	33.863	2.35	2.02	0.86
50	E-3	71.967	-48.702	125	33.888	2.35	2.02	0.86
50	E-3	71.967	-48.702	150	33.886	2.35	2.09	0.89
50	E-3	71.967	-48.702	200	33.935	2.35	2.26	0.96
50	E-3	71.967	-48.702	250	34.105	2.37	2.40	1.02
50	E-3	71.967	-48.702	300	34.208	2.37	2.47	1.04
50	E-3	71.967	-48.702	400	34.352	2.39	2.55	1.07
50	E-3	71.967	-48.702	500	34.464	2.39	2.51	1.05
50	E-3	71.967	-48.702	600	34.519	2.40	2.48	1.04
50	E-3	71.967	-48.702	700	34.573	2.40	2.44	1.02
50	E-3	71.967	-48.702	900	34.648	2.41	2.43	1.01
63	F-L	74.659	-48.532	20	33.745	2.34	1.82	0.78
63	F-L	74.659	-48.532	40	33.749	2.34	2.02	0.87
63	F-L	74.659	-48.532	80	33.752	2.34	2.16	0.92
63	F-L	74.658	-48.532	100	33.797	2.34	2.28	0.97
63	F-L	74.659	-48.532	125	33.838	2.34	2.39	1.02
63	F-L	74.658	-48.532	150	33.882	2.35	2.31	0.98
63	F-L	74.659	-48.532	200	33.907	2.35	2.27	0.97
63	F-L	74.659	-48.532	250	33.989	2.36	2.28	0.97
63	F-L	74.659	-48.532	300	34.083	2.36	2.36	1.00
63	F-L	74.659	-48.532	400	34.209	2.37	2.33	0.98
63	F-L	74.659	-48.532	500	34.358	2.39	2.31	0.97
63	F-L	74.659	-48.532	600	34.391	2.39	2.34	0.98
63	F-L	74.659	-48.532	700	34.514	2.40	2.42	1.01
63	F-L	74.659	-48.532	900	34.61	2.41	2.40	1.00
81	E-4W	71.425	-48.765	10	33.9	2.35	1.92	0.82

81	E-4W	71.425	-48.765	40	33.901	2.35	1.96	0.83
81	E-4W	71.425	-48.765	70	33.901	2.35	1.97	0.84
81	E-4W	71.425	-48.765	90	33.918	2.35	2.19	0.93
81	E-4W	71.425	-48.765	125	33.917	2.35	2.19	0.93
81	E-4W	71.425	-48.765	150	33.914	2.35	2.35	1.00
81	E-4W	71.425	-48.765	200	34.07	2.36	2.51	1.06
81	E-4W	71.425	-48.765	250	34.169	2.37	2.34	0.99
81	E-4W	71.425	-48.765	300	34.238	2.38	2.37	1.00
81	E-4W	71.425	-48.765	400	34.37	2.39	2.36	0.99
81	E-4W	71.425	-48.766	500	34.459	2.39	2.38	0.99
81	E-4W	71.425	-48.765	600	34.511	2.40	2.39	1.00
81	E-4W	71.425	-48.765	700	34.544	2.40	2.43	1.01
81	E-4W	71.425	-48.765	900	34.602	2.40	2.38	0.99
94	E-4E	72.563	-48.715	20	33.833	2.34	1.83	0.78
94	E-4E	72.563	-48.715	40	33.834	2.34	1.92	0.82
94	E-4E	72.563	-48.715	80	33.874	2.35	2.13	0.91
94	E-4E	72.563	-48.715	100	33.876	2.35	2.23	0.95
94	E-4E	72.563	-48.715	125	33.893	2.35	2.28	0.97
94	E-4E	72.563	-48.715	150	33.907	2.35	2.25	0.96
94	E-4E	72.563	-48.715	200	33.941	2.35	2.34	0.99
94	E-4E	72.563	-48.715	250	34.114	2.37	2.35	0.99
94	E-4E	72.563	-48.715	300	34.218	2.37	2.35	0.99
94	E-4E	72.563	-48.715	400	34.355	2.39	2.38	1.00
94	E-4E	72.563	-48.715	500	34.462	2.39	2.43	1.01
94	E-4E	72.563	-48.715	600	34.534	2.40	2.43	1.01
94	E-4E	72.563	-48.715	700	34.585	2.40	2.44	1.01
94	E-4E	72.563	-48.715	900	34.664	2.41	2.38	0.99
107	A3-2	72.056	-50.624	10	33.912	2.35	2.09	0.89
107	A3-2	72.056	-50.624	40	33.913	2.35	2.09	0.89
107	A3-2	72.056	-50.624	80	33.914	2.35	2.20	0.94
107	A3-2	72.056	-50.624	125	33.915	2.35	2.21	0.94
107	A3-2	72.056	-50.624	150	33.914	2.35	2.20	0.94
107	A3-2	72.056	-50.624	175	33.921	2.35	2.23	0.95
107	A3-2	72.056	-50.624	200	33.942	2.35	2.29	0.97
107	A3-2	72.056	-50.624	270	34.061	2.36	2.34	0.99
107	A3-2	72.056	-50.624	300	34.118	2.37	2.32	0.98
107	A3-2	72.056	-50.624	400	34.291	2.38	2.30	0.97
107	A3-2	72.056	-50.624	500	34.395	2.39	1.63	0.68
114	E-5	71.9	-48.412	20	33.837	2.34	1.91	0.81
114	E-5	71.9	-48.412	40	33.847	2.35	1.91	0.81
114	E-5	71.9	-48.412	80	33.851	2.35	1.94	0.83
114	E-5	71.9	-48.412	100	33.88	2.35	1.92	0.82
114	E-5	71.9	-48.412	125	33.891	2.35	2.04	0.87
114	E-5	71.9	-48.412	150	33.893	2.35	2.15	0.92
114	E-5	71.9	-48.412	200	33.92	2.35	2.36	1.00
114	E-5	71.9	-48.412	250	34.1	2.37	2.41	1.02

114	E-5	71.9	-48.412	300	34.213	2.37	2.44	1.03
114	E-5	71.9	-48.412	400	34.366	2.39	2.45	1.03
114	E-5	71.9	-48.412	500	34.458	2.39	2.47	1.03
114	E-5	71.9	-48.412	600	34.508	2.40	2.41	1.01
114	E-5	71.9	-48.412	700	34.563	2.40	2.40	1.00
114	E-5	71.9	-48.412	900	34.645	2.41	2.39	0.99

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Table S2. Particulate  $^{234}\text{Th}$  activity ( $\text{dpm L}^{-1}$ ) and Particulate Organic Carbon (POC) concentration ( $\mu\text{mol L}^{-1}$ ), and associated C:Th ratio in small (1-53  $\mu\text{m}$ ) and large (53  $\mu\text{m}$ ) particles collected via in situ pumps during KEOPS2

Cast	Station	Longitude	Latitude	depth	1-53 $\mu\text{m}$			>53 $\mu\text{m}$		
					$^{234}\text{Th}$	POC	C:Th	$^{234}\text{Th}$	POC	C:Th
#	#	$^{\circ}\text{E}$	$^{\circ}\text{S}$	m	$\text{dpm L}^{-1}$	$\mu\text{mol L}^{-1}$	$\mu\text{mol dpm}^{-1}$	$\text{dpm L}^{-1}$	$\mu\text{mol L}^{-1}$	$\frac{\mu\text{mol}}{\text{dpm}}$
ISP1	A3-1	72°05'	50°38'	40	0.276	2.66	9.6	0.016	0.11	7.3
ISP1	A3-1	72°05'	50°38'	100	0.243	2.30	9.5	0.019	0.13	6.9
ISP1	A3-1	72°05'	50°38'	250	0.168	0.79	4.7	0.027	0.10	3.7
ISP1	A3-1	72°05'	50°38'	440	0.239	0.88	3.7	0.012	0.09	6.9
ISP3	R-2	66°42'	50°23'	25	0.29	2.80	9.6	0.041	0.36	8.6
ISP3	R-2	66°42'	50°23'	110	0.27	2.05	7.5	0.039	0.38	9.8
ISP3	R-2	66°42'	50°23'	150	0.17	1.08	6.4	0.024	0.13	5.6
ISP3	R-2	66°42'	50°23'	180	0.14	0.86	6.0	0.017	0.08	4.7
ISP2	R-2	66°43'	50°22'	700	0.08	0.17	2.3	0.004	0.01	3.1
ISP2	R-2	66°43'	50°22'	1020	0.07	0.24	3.4	0.003	0.01	4.0
ISP5	E-1	72°12'	48°28'	40	0.397	4.07	10.3	0.105	1.20	11.4
ISP5	E-1	72°12'	48°28'	90	0.302	2.21	7.3	0.121	1.46	12.1
ISP5	E-1	72°12'	48°28'	130	0.158	1.23	7.8	0.177	1.01	5.7
ISP5	E-1	72°12'	48°28'	170	0.101	1.06	10.5	0.198	1.05	5.3
ISP5	E-1	72°12'	48°28'	280	0.103	0.46	4.4	0.033	0.10	2.9
ISP4	E-1	72°14'	48°30'	610	0.088	0.26	2.9	0.010	0.03	2.8
ISP4	E-1	72°14'	48°30'	960	0.059	0.21	3.6	0.006	0.02	3.1
ISP6	E-3	71°56'	48°42'	90	0.363	2.61	7.2	0.062	0.58	9.4
ISP6	E-3	71°56'	48°42'	130	0.198	1.27	6.4	0.126	0.90	7.2
ISP6	E-3	71°56'	48°42'	190	0.141	0.66	4.6	0.043	0.18	4.2
ISP6	E-3	71°56'	48°42'	280	0.153	0.49	3.2	0.016	0.06	3.5
ISP7	E-3	71°58'	48°42'	600	0.098	0.23	2.3	0.009	0.02	2.5
ISP8	F-L	74°40'	48°31'	40	0.344	7.40	21.5	0.558	n.d	-
ISP8	F-L	74°40'	48°31'	70	0.035	0.20	5.7	0.051	n.d	-
ISP8	F-L	74°40'	48°31'	130	0.143	0.61	4.2	0.023	0.10	4.5
ISP8	F-L	74°40'	48°31'	190	0.138	0.46	3.3	0.020	0.06	3.2
ISP8	F-L	74°40'	48°31'	280	0.130	0.35	2.7	0.012	0.03	2.3
ISP9	F-L	74°39'	48°32'	350	0.101	0.29	2.8	0.006	n.d	-
ISP9	F-L	74°39'	48°32'	500	0.142	0.30	2.1	0.006	0.01	1.6
ISP9	F-L	74°39'	48°32'	800	0.104	0.27	2.6	0.008	0.01	1.4
ISP10	E-4W	71°26'	48°46'	90	0.262	1.47	5.6	0.085	0.50	5.9
ISP10	E-4W	71°26'	48°46'	110	0.142	1.24	8.7	0.212	1.59	7.5
ISP10	E-4W	71°26'	48°46'	130	0.142	0.96	6.8	0.111	0.44	4.0
ISP10	E-4W	71°26'	48°46'	190	0.119	0.72	6.0	0.072	0.26	3.6
ISP10	E-4W	71°26'	48°46'	280	0.166	0.47	2.8	0.035	0.07	2.1
ISP11	E-4E	72°34'	48°43'	50	0.271	2.75	10.2	0.075	0.52	6.9
ISP11	E-4E	72°34'	48°43'	100	0.222	1.62	7.3	0.057	0.19	3.3
ISP11	E-4E	72°34'	48°43'	150	0.121	0.73	6.1	0.067	0.27	4.1
ISP11	E-4E	72°34'	48°43'	200	0.131	0.54	4.1	0.020	0.06	2.9
ISP11	E-4E	72°34'	48°43'	300	0.123	0.34	2.8	0.012	0.04	3.6
ISP12	A3-2	72°03'	50°37'	55	0.172	2.26	13.1	0.490	3.89	7.9
ISP12	A3-2	72°03'	50°37'	110	0.192	2.38	12.4	0.267	2.76	10.3
ISP12	A3-2	72°03'	50°37'	165	0.093	1.27	13.7	0.397	3.18	8.0
ISP12	A3-2	72°03'	50°37'	200	0.123	0.70	5.7	0.082	0.26	3.1
ISP12	A3-2	72°03'	50°37'	440	0.148	0.53	3.6	0.019	0.05	2.7
ISP14	E-5	71°54'	48°25'	35	0.385	4.06	10.5	0.323	3.61	11.2
ISP14	E-5	71°54'	48°25'	120	0.126	0.90	7.2	0.132	0.59	4.5
ISP14	E-5	71°54'	48°25'	220	0.117	0.58	4.9	0.035	0.12	3.5

ISP14	E-5	71°54'	48°25'	300	0.129	0.48	3.7	0.020	0.07	3.3
ISP15	E-5	71°54'	48°25'	400	0.142	0.42	3.0	0.014	0.08	6.0
ISP15	E-5	71°54'	48°25'	600	0.169	0.30	1.8	n.d	0.01	-
ISP15	E-5	71°54'	48°25'	900	0.113	0.29	2.5	0.004	0.02	5.6

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n.d. not determined



Table S3.  $^{234}\text{Th}$  flux ( $\text{dpm m}^{-2} \text{d}^{-1}$ ) for transect stations estimated at 100 m, 150 m, and 200 m depth based on SS model.

Station	Date	Depth (m)	$^{234}\text{Th}$ flux ( $\text{dpm m}^{-2} \text{d}^{-1}$ )
TNS-8	21 oct.	100	942 ± 183
TNS-8	21 oct.	150	1247 ± 221
TNS-8	21 oct.	200	1372 ± 255
TNS-6	22 oct.	100	794 ± 203
TNS-6	22 oct.	150	1152 ± 238
TNS-6	22 oct.	200	1328 ± 259
TNS-1	23 oct.	100	600 ± 203
TNS-1	23 oct.	150	646 ± 239
TNS-1	23 oct.	200	567 ± 252
E-2	1 nov.	100	664 ± 172
E-2	1 nov.	150	921 ± 216
E-2	1 nov.	200	1092 ± 253
TEW-8	2 nov.	100	886 ± 162
TEW-8	2 nov.	150	1050 ± 199
TEW-8	2 nov.	200	1131 ± 233

Figure S1. Latitudinal section of total  $^{234}\text{Th}/^{238}\text{U}$  activity ratios, temperature and salinity obtained during the South to North transect from station A3 to station TNS-1 . Schlitzer, 2003; Ocean Data View; <http://www.awi-bremerhaven.de/GEO/ODV>.

