

Supplementary Information

Table S1. Major and trace element concentrations and elemental ratios in bulk sediments of BC-10 core.

Mid Depth	Mg	Al	K	Ti	Mn	Fe	MSI	V	Cr	Co	Ni	Cu	Zn	Co/Zn
cm	wt.%	wt.%	wt.%	wt.%	wt.%	wt.%		μg/g	μg/g	μg/g	μg/g	μg/g	μg/g	
0.5	4.60	6.7	1.26	0.42	0.83	7.5	44.5	130	267	87	336	254	157	0.55
1.5	4.58	6.6	1.26	0.43	0.78	7.2	45.2	127	273	86	339	247	149	0.57
2.5	4.65	6.6	1.26	0.42	0.79	7.4	44.6	126	274	85	345	246	163	0.52
3.5	4.61	6.7	1.26	0.42	0.79	7.4	45.0	127	274	86	335	246	146	0.59
4.5	4.63	6.6	1.24	0.44	0.79	7.3	44.7	132	278	87	340	249	153	0.57
5.5	4.58	6.5	1.22	0.43	0.77	7.3	44.8	127	270	85	335	244	145	0.59
6.5	4.70	6.6	1.23	0.44	0.79	7.4	44.7	130	284	88	358	253	146	0.60
7.5	4.62	6.6	1.27	0.45	0.80	7.4	44.7	133	278	89	349	250	146	0.61
8.5	4.59	6.7	1.24	0.45	0.78	7.4	45.1	134	296	88	356	255	148	0.60
9.5	4.75	6.8	1.27	0.45	0.81	7.5	44.9	136	299	92	366	267	150	0.61
10.5	4.75	6.7	1.24	0.46	0.79	7.5	44.6	132	296	91	362	256	159	0.57
11.5	4.69	6.7	1.23	0.46	0.79	7.4	45.0	136	291	89	356	253	147	0.61
12.5	4.66	6.7	1.26	0.45	0.78	7.4	45.0	136	301	91	355	252	195	0.47
13.5	4.60	6.6	1.25	0.46	0.79	7.4	44.8	133	290	87	344	250	150	0.58
14.5	4.61	6.8	1.23	0.46	0.80	7.5	44.9	138	293	90	350	255	157	0.57
15.5	4.51	6.6	1.24	0.46	0.79	7.3	44.9	131	272	89	343	251	186	0.48
16.5	4.64	6.6	1.24	0.46	0.79	7.3	45.0	137	288	90	350	252	141	0.64
17.5	4.65	6.7	1.21	0.48	0.76	7.3	45.5	138	296	89	358	250	174	0.52
18.5	4.63	6.8	1.24	0.47	0.80	7.4	45.1	138	296	92	359	258	151	0.61
19.5	4.53	6.5	1.26	0.46	0.78	7.2	44.7	137	290	91	346	253	151	0.60
20.5	4.60	6.7	1.24	0.47	0.82	7.4	44.7	140	281	89	345	250	138	0.65
21.5	4.53	6.5	1.23	0.47	0.79	7.2	44.9	135	278	87	340	248	126	0.69

22.5	4.60	6.6	1.27	0.48	0.80	7.3	44.9	142	291	89	350	251	111	0.80
23.5	4.52	6.4	1.28	0.48	0.78	7.2	44.4	136	291	89	351	248	118	0.75
24.5	4.62	6.4	1.30	0.49	0.80	7.3	44.1	140	287	89	353	250	115	0.78
25.5	4.57	6.4	1.27	0.48	0.80	7.3	44.3	142	285	90	358	254	132	0.69
26.5	4.54	6.4	1.32	0.48	0.76	7.2	44.6	134	279	85	336	247	145	0.58
27.5	4.51	6.4	1.33	0.48	0.78	7.3	44.2	138	300	86	338	244	113	0.76
28.5	4.51	6.3	1.29	0.48	0.77	7.2	44.4	135	277	85	331	237	123	0.69
29.5	4.53	6.1	1.29	0.48	0.76	7.2	43.6	137	310	88	340	238	135	0.65
30.5	4.68	6.3	1.30	0.48	0.78	7.2	43.9	136	314	87	356	238	129	0.67
31.5	4.68	6.4	1.36	0.49	0.79	7.3	44.0	138	299	88	361	243	121	0.73
32.5	4.82	6.3	1.31	0.50	0.73	7.2	44.0	134	321	85	365	236	116	0.73
33.5	4.75	6.3	1.38	0.51	0.77	7.4	43.6	134	307	87	365	237	116	0.75
34.5	4.43	6.5	1.39	0.49	0.79	7.4	44.1	138	274	85	324	237	114	0.75
35.5	4.56	6.3	1.35	0.49	0.79	7.3	43.9	137	288	87	343	237	154	0.56
36.5	4.60	6.2	1.38	0.49	0.81	7.3	43.1	138	297	90	359	252	158	0.57
37.5	4.74	5.9	1.29	0.45	0.76	7.1	43.0	133	310	86	361	234	135	0.64
38.5	5.04	6.2	1.31	0.46	0.78	7.4	43.3	138	351	91	397	240	140	0.65
39.5	5.24	5.9	1.26	0.46	0.75	7.2	42.8	136	371	91	429	238	116	0.78
JMS-1 (Measu red)	1.74	8.6	1.93	0.44	0.08	4.98	—	127	136	—	54	85	268	—
JMS-1 (Certifi ed)	1.73	8.4	1.87	0.42	0.08	4.82	—	126	133	18	53	88	264	—
JMS-2 (Measu red)	1.91	7.3	2.23	0.84	1.79	7.48	—	183	—	225	301	460	158	—
JMS-2 (Certifi ed)	1.95	7.5	2.25	0.84	1.75	7.67	—	184	78	226	311	447	166	—

Table S2. Rare earth element concentrations, Eu/Eu*, Ce/Ce*, and elemental ratios in bulk sediments of BC-10 core (PN represents Post-Archean Australian Shale normalized) .

Mid Depth	La	Ce	Nd	Sm	Eu	Gd	Dy	Ho	Er	Tm	Yb	Lu	Eu/Eu* _{PN}	Ce/Ce* _{PN}	Nd _{PN} /Yb _{PN}
cm	μg/g	μg/g	μg/g	μg/g	μg/g	μg/g	μg/g	μg/g	μg/g	μg/g	μg/g	μg/g			
0.5	34.0	80.7	45.5	10.5	2.7	9.6	9.8	1.7	5.1	0.74	4.79	0.77	1.28	0.91	0.79
1.5	33.9	78.9	44.4	10.1	2.7	9.3	9.7	1.8	5.4	0.70	4.48	0.75	1.29	0.90	0.82
2.5	33.3	77.3	44.0	10.0	2.6	9.1	9.5	1.7	5.1	0.73	4.44	0.76	1.27	0.90	0.82
3.5	33.1	79.0	43.9	9.4	2.6	9.3	9.7	1.6	5.3	0.68	4.58	0.77	1.32	0.92	0.80
4.5	32.3	78.6	41.8	9.7	2.7	9.0	10.3	1.7	5.4	0.71	4.71	0.72	1.33	0.95	0.74
5.5	32.1	77.0	43.8	9.7	2.5	8.8	9.0	1.6	5.2	0.66	4.56	0.64	1.30	0.91	0.80
6.5	32.8	78.1	42.2	10.2	2.5	9.1	9.7	1.6	5.2	0.63	4.75	0.73	1.21	0.93	0.74
7.5	32.8	79.7	43.6	9.6	2.5	9.3	9.9	1.7	5.3	0.68	4.47	0.67	1.23	0.93	0.81
8.5	32.0	77.4	41.7	9.8	2.7	9.1	9.3	1.6	5.5	0.65	4.79	0.74	1.35	0.94	0.72
9.5	33.2	81.2	43.8	10.4	2.6	9.1	9.7	1.7	5.3	0.64	4.64	0.67	1.28	0.94	0.79
10.5	32.2	78.3	42.6	9.9	2.6	8.8	9.5	1.7	5.2	0.60	4.65	0.70	1.29	0.94	0.76
11.5	32.0	78.7	41.6	10.3	2.3	8.7	9.5	1.7	5.2	0.61	4.43	0.70	1.15	0.96	0.78
12.5	32.6	78.7	42.0	9.4	2.4	8.9	9.2	1.6	5.2	0.64	4.21	0.67	1.25	0.94	0.83
13.5	31.5	77.6	44.0	9.3	2.3	8.8	9.2	1.6	5.0	0.61	4.28	0.62	1.17	0.92	0.86
14.5	32.1	78.5	43.1	9.7	2.4	8.6	9.1	1.6	5.0	0.60	4.21	0.63	1.25	0.93	0.85
15.5	31.4	77.8	40.3	9.6	2.4	8.3	9.0	1.6	5.0	0.61	4.25	0.59	1.25	0.97	0.79
16.5	32.2	78.3	41.3	9.0	2.4	8.5	9.1	1.5	5.3	0.59	4.21	0.68	1.28	0.96	0.82
17.5	31.4	75.1	41.8	9.6	2.5	8.5	9.3	1.6	5.2	0.62	4.48	0.70	1.31	0.92	0.78
18.5	32.6	79.8	42.7	10.6	2.4	8.9	9.7	1.6	5.2	0.62	4.58	0.65	1.18	0.95	0.77
19.5	32.0	77.8	42.3	9.2	2.7	8.8	9.4	1.6	5.0	0.58	4.41	0.66	1.39	0.94	0.80
20.5	32.5	78.8	42.0	9.8	2.4	8.6	9.2	1.6	5.1	0.63	4.33	0.58	1.24	0.95	0.81
21.5	32.3	75.9	41.8	9.5	2.5	8.0	8.8	1.5	5.0	0.60	4.22	0.63	1.34	0.92	0.82
22.5	32.4	79.1	41.5	10.4	2.4	8.7	9.2	1.6	5.0	0.60	4.46	0.63	1.21	0.96	0.78
23.5	32.3	78.3	43.6	9.0	2.4	8.5	9.1	1.5	4.9	0.62	4.30	0.62	1.29	0.92	0.84
24.5	33.0	79.1	41.8	9.8	2.4	8.5	9.5	1.6	5.2	0.60	4.56	0.59	1.25	0.95	0.76

25.5	32.4	79.6	42.7	9.8	2.5	8.5	9.2	1.6	5.0	0.60	4.27	0.68	1.28	0.95	0.83
26.5	31.8	76.0	42.0	9.7	2.4	8.2	9.1	1.6	4.8	0.58	4.26	0.66	1.25	0.92	0.82
27.5	33.0	77.6	41.9	9.7	2.6	8.6	8.9	1.5	4.8	0.61	4.22	0.61	1.35	0.93	0.83
28.5	32.3	76.6	41.7	9.9	2.4	8.4	9.4	1.6	5.0	0.60	4.42	0.67	1.22	0.93	0.79
29.5	32.3	75.1	41.7	10.2	2.4	8.3	8.8	1.5	4.8	0.59	4.29	0.63	1.23	0.91	0.81
30.5	32.9	76.2	42.3	9.6	2.4	8.5	9.2	1.6	5.2	0.59	4.34	0.66	1.28	0.91	0.81
31.5	33.9	76.4	42.2	10.2	2.5	8.5	9.3	1.7	5.2	0.58	4.18	0.65	1.24	0.90	0.84
32.5	31.7	71.9	42.4	9.6	2.3	8.5	9.2	1.6	5.1	0.60	4.07	0.65	1.21	0.87	0.87
33.5	32.6	76.6	43.1	10.2	2.5	8.7	9.0	1.6	5.0	0.65	4.32	0.60	1.25	0.91	0.83
34.5	33.8	79.5	44.0	10.3	2.5	8.9	9.5	1.6	5.2	0.64	4.29	0.64	1.25	0.92	0.85
35.5	33.9	77.7	42.8	10.1	2.5	8.7	9.2	1.8	5.1	0.65	4.39	0.66	1.28	0.91	0.81
36.5	35.2	80.2	43.9	10.2	2.6	8.9	9.8	1.6	5.3	0.59	4.50	0.64	1.28	0.91	0.81
37.5	32.5	73.4	42.2	9.6	2.4	8.4	9.1	1.5	4.9	0.58	4.09	0.59	1.25	0.88	0.86
38.5	32.3	75.0	42.8	9.7	2.6	8.6	9.2	1.7	5.0	0.61	4.39	0.63	1.32	0.89	0.81
39.5	30.8	71.9	41.3	9.5	2.3	8.2	8.9	1.5	4.6	0.58	4.10	0.54	1.24	0.89	0.84

Table S3. Down core variation of different Fe phases in BC-10 core.

Mid Depth	Fe _{Acetate}	Fe _{HA-HCl}	Fe _{Dithionite}	Fe _{Oxalate}	Fe _{HCl}	Fe _{Res}
cm	wt. %	wt. %	wt. %	wt. %	wt. %	wt. %
0.5	0.48	2.57	1.36	0.68	1.18	0.90
4.5	0.37	2.41	1.26	0.63	1.21	0.87
8.5	0.40	2.89	1.17	0.57	1.21	0.83
12.5	0.44	1.82	1.56	0.91	1.53	0.78
16.5	0.45	2.19	1.36	0.81	1.45	0.73
20.5	0.43	1.90	1.57	0.90	1.49	0.75
24.5	0.44	1.94	1.49	0.92	1.43	0.75
28.5	0.38	1.88	1.47	0.96	1.38	0.76
32.5	0.28	1.83	1.54	0.98	1.59	0.88
36.5	0.32	2.04	1.50	0.84	1.52	0.78

Table S4. Based on average data, the relative percentages of Fe, Mn, Al, and Mg measured in different Fe phases.

Elements	Fe _{Acetate} (%)	Fe _{HA-HCl} (%)	Fe _{Dithionite} (%)	Fe _{Oxalate} (%)	Fe _{HCl} (%)	Fe _{Res} (%)
Fe	5.7	30.7	20.4	11.7	20.0	11.5
Mn	4.6	89.1	1.6	1.2	1.7	1.8
Mg	12.4	10.2	2.2	20.8	32.1	22.2
Al	4.2	11.1	1.6	11.2	15.4	56.4