



Figure 6. Cross plots of sea surface temperature and atmospheric carbon dioxide ($r = 0.853$, $N = 51$, $p < 0.001$; Table S3). The shade shows 95% confidence interval. Atmospheric CO_2 concentrations are from the GEOCARBSULF model (Royer et al., 2014).

Table S1. Mean sea surface temperature per million years in the Phanerozoic. Data are from Dataset S1. $\text{Range}_{95\%CI}$ is the range of 95% confidence interval.

Age (Ma)	Mean temperature (°C)	Number	$\text{Range}_{95\%CI}$
0	18.22	1618	0.20
1	15.38	1053	0.11
2	16.19	1018	0.10
3	17.16	1634	0.09
4	17.47	2072	0.08
5	17.13	1506	0.09
6	15.19	222	0.26
7	15.67	60	0.55
8	16.11	51	0.89
9	16.99	72	0.66
10	18.94	74	0.82
11	17.78	90	0.58
12	16.57	68	0.84
13	15.25	152	0.20
14	16.74	35	0.81
15	17.09	30	0.96
16	17.64	21	1.13
17	16.83	27	1.12
18	15.43	38	0.93
20	16.64	36	0.82
22	19.03	45	0.93

23	18.61	31	0.98
24	18.49	31	1.42
26	14.09	6	0.92
27	15.24	5	2.01
28	14.47	8	2.17
29	15.22	14	0.76
30	15.67	14	2.56
32	21.80	46	1.15
33	21.25	178	0.39
34	21.79	228	0.43
35	22.17	69	1.14
37	16.21	31	1.65
39	16.80	64	0.86
41	17.82	76	0.69
42	18.07	34	1.73
43	18.43	36	1.38
44	15.74	19	0.71
45	21.54	65	1.11
46	19.80	278	0.27
47	17.41	15	0.69
48	21.81	14	2.65
49	23.75	31	1.45
50	22.98	27	1.43
51	20.88	14	1.74
52	22.07	11	2.33
53	22.38	23	2.17
54	20.43	26	1.88
55	26.45	94	0.89
56	20.06	54	1.04
57	18.33	26	1.03
58	18.34	23	1.32
59	20.06	24	1.51
60	17.15	47	0.55
61	17.49	25	1.14
62	15.81	15	0.89
63	15.62	7	0.99
66	18.81	32	0.99
67	17.09	74	0.50
68	17.92	197	0.49
69	15.82	140	0.45
70	15.96	124	0.36
71	15.89	173	0.26
72	16.25	120	0.42

73	17.30	85	0.68
74	16.95	59	0.43
75	16.45	92	0.35
76	20.26	182	0.77
77	19.08	91	1.09
78	19.47	77	1.30
79	18.06	98	0.95
80	16.70	3	0.93
82	27.63	33	2.16
84	22.07	20	2.80
86	29.91	46	0.57
87	28.72	24	1.58
88	29.79	63	0.56
89	29.71	80	0.69
90	30.45	42	0.61
91	31.97	112	0.45
92	31.93	226	0.17
93	31.75	371	0.13
94	31.66	124	0.24
95	30.03	135	0.65
96	24.98	185	0.62
97	28.37	172	0.51
98	27.86	86	0.94
99	24.77	63	1.09
100	25.44	53	1.02
101	24.66	302	0.21
102	24.10	387	0.22
103	24.01	83	0.54
104	23.54	63	0.81
105	22.89	54	0.62
106	22.08	9	1.65
107	20.90	4	1.12
108	19.91	4	3.21
109	20.60	5	2.62
112	19.45	7	4.30
116	22.86	7	1.92
117	24.28	12	2.44
118	24.33	2	1.06
119	22.68	5	3.25
120	21.66	15	0.62
121	20.22	24	0.54
122	21.49	36	1.21
123	21.42	31	1.51

124	20.87	92	0.11
125	20.74	181	0.20
126	20.84	58	0.55
127	20.50	12	3.06
128	17.87	14	0.90
129	25.24	39	2.23
130	23.40	79	1.16
131	21.25	43	1.60
132	21.30	41	1.25
133	22.00	25	1.89
134	20.69	19	2.14
135	18.56	20	2.00
136	18.17	26	1.57
137	16.29	38	0.42
138	16.94	11	0.82
139	19.39	22	1.36
140	17.80	28	0.60
141	18.06	7	3.09
142	17.25	6	1.20
145	17.85	5	3.93
150	19.30	1	
153	19.29	58	1.01
154	20.44	9	3.00
156	24.39	5	2.45
157	19.12	7	3.98
158	20.51	5	4.37
159	20.07	25	2.09
160	21.80	34	1.68
161	19.40	10	2.52
162	16.76	23	1.14
164	19.43	102	0.72
165	23.52	17	1.70
166	22.66	57	0.93
167	25.16	111	0.45
168	24.88	10	2.40
169	25.34	12	1.44
170	20.05	49	0.95
171	23.02	21	1.18
172	25.71	9	2.86
173	21.07	13	1.13
174	23.05	4	5.02
175	26.20	12	2.09
176	29.07	14	2.63

177	24.46	8	3.27
178	26.51	17	1.76
179	25.41	33	1.31
180	26.58	55	1.14
181	24.08	153	0.58
182	22.23	195	0.44
183	18.88	189	0.51
184	18.38	93	0.59
185	20.02	28	1.23
186	18.85	54	0.77
187	21.91	40	0.84
188	22.54	86	0.80
189	21.14	129	0.43
190	21.42	134	0.42
191	20.42	59	0.69
192	20.44	19	1.07
193	21.67	5	2.19
195	21.16	9	2.50
197	22.88	7	3.42
198	16.44	15	1.41
199	19.66	16	1.85
200	20.81	19	2.45
201	15.24	187	0.39
202	12.08	56	0.62
203	15.61	166	0.32
204	18.35	6	2.83
205	19.65	10	1.22
206	20.04	11	1.75
207	20.98	7	3.78
209	21.46	5	5.66
210	22.81	4	4.54
211	23.53	4	4.21
212	24.41	4	4.35
214	26.29	6	3.94
217	24.21	3	6.92
222	19.93	1	
226	21.44	3	4.99
230	23.46	141	0.38
231	23.52	11	4.15
232	24.17	10	3.51
234	22.64	4	5.51
235	19.57	9	2.77
236	24.72	8	1.65

237	22.27	4	4.64
238	25.25	4	4.41
240	27.97	13	3.03
242	26.11	20	1.94
244	31.39	11	3.59
245	28.53	13	4.70
246	22.98	10	3.92
247	23.87	25	2.08
248	25.98	28	1.61
249	29.28	6	1.45
250	29.80	12	1.54
251	29.94	32	0.97
252	23.84	259	0.75
253	18.57	67	0.77
254	20.21	67	0.78
255	20.54	8	4.34
256	21.29	14	1.64
257	22.86	19	0.85
258	23.11	15	1.36
259	22.93	26	1.26
260	20.56	26	0.86
261	23.25	18	1.01
262	18.79	7	3.53
264	19.30	4	1.01
265	18.50	9	1.84
266	17.00	17	1.20
268	20.59	4	3.31
270	18.42	8	1.86
271	17.30	3	2.64
272	17.63	8	2.27
274	17.61	5	2.92
275	16.54	9	1.62
276	14.38	7	2.48
277	15.06	3	4.88
279	17.41	8	2.14
282	14.54	4	4.92
285	15.45	6	2.17
288	17.42	3	5.13
290	15.66	4	3.74
291	14.13	5	3.67
292	16.40	6	4.18
293	14.15	5	2.35
294	12.32	8	1.71

295	16.91	7	4.89
296	15.71	7	3.16
297	14.23	13	1.39
298	12.85	8	2.32
299	17.47	23	1.83
300	17.20	9	2.71
301	20.00	50	0.83
302	22.45	41	2.10
303	20.51	15	4.40
304	18.10	11	4.05
305	20.49	21	2.81
306	22.13	15	4.58
307	21.25	11	4.98
308	22.18	18	3.87
310	21.73	16	3.65
311	20.51	7	3.50
312	15.43	8	5.36
313	16.29	12	2.10
314	13.50	11	0.89
315	11.28	17	0.74
316	10.94	18	1.07
317	11.77	9	0.77
318	9.42	8	1.17
319	9.37	3	7.14
321	10.54	5	5.25
322	11.18	3	0.96
323	12.37	4	1.95
324	12.97	13	0.48
325	13.50	16	1.49
326	12.33	16	1.45
327	15.36	17	1.62
328	15.84	14	1.87
329	15.13	14	1.43
330	13.76	13	1.17
331	14.04	14	3.24
332	13.00	3	4.30
333	13.47	4	2.78
334	13.04	10	2.37
335	13.02	5	3.96
336	14.87	4	6.31
339	18.54	9	7.18
345	20.60	8	2.26
347	20.12	16	1.72

348	20.33	10	0.96
349	21.14	6	3.64
350	23.04	19	2.20
351	23.92	44	1.41
352	23.67	32	1.36
353	27.34	45	1.20
355	29.36	3	6.87
356	28.04	5	4.27
357	27.94	10	2.93
358	27.17	45	1.25
359	27.03	23	1.03
360	28.43	9	2.31
361	27.57	18	0.82
362	31.35	12	0.79
363	29.40	13	2.15
364	29.85	14	1.68
365	30.03	18	1.88
366	30.77	25	1.13
367	31.74	23	1.11
368	33.10	14	1.17
369	34.73	13	2.80
370	32.95	25	1.08
371	32.65	44	0.81
372	31.22	52	0.75
373	33.52	49	0.64
374	31.64	69	0.60
375	30.89	44	0.84
376	31.11	11	2.75
379	24.59	8	2.14
381	25.77	7	2.34
382	24.35	18	1.22
383	25.59	45	1.03
384	31.70	63	1.53
385	34.44	20	2.66
386	25.15	6	0.42
387	24.89	21	0.99
388	24.31	3	1.68
389	28.26	7	2.45
390	27.53	11	2.01
391	26.08	37	0.92
392	25.03	20	1.38
393	25.03	14	2.19
394	26.26	9	3.02

395	24.92	9	2.32
396	24.42	9	3.89
398	23.73	6	3.98
400	24.54	6	4.25
403	33.18	6	2.78
405	30.55	3	2.53
406	27.00	4	0.25
407	26.70	4	0.65
409	28.90	9	1.30
410	29.86	28	1.00
412	34.42	11	2.64
414	35.55	17	1.14
415	33.54	3	2.19
416	32.46	11	0.71
421	31.80	3	2.16
422	29.39	5	2.16
423	30.03	3	3.57
424	27.84	9	1.36
425	32.54	16	1.15
426	30.69	7	2.81
427	28.36	5	2.59
428	28.02	8	1.42
429	25.73	7	2.65
430	26.92	8	1.66
431	28.04	16	1.06
432	26.02	21	1.84
433	30.22	12	1.88
434	28.52	9	1.19
435	31.28	12	1.75
436	30.14	10	0.82
437	31.26	6	2.35
438	30.60	6	2.54
439	29.17	9	1.75
441	29.21	6	1.14
442	26.87	5	2.83
443	26.14	14	1.08
444	24.71	43	1.44
445	26.14	20	3.04
446	25.28	7	2.69
447	29.78	29	1.21
448	28.25	27	0.97
449	29.04	19	2.39
450	28.37	24	0.76

451	27.79	76	0.54
452	27.93	134	0.47
453	27.86	87	0.88
454	27.13	10	1.34
459	31.14	5	2.96
460	30.56	8	1.17
462	34.71	4	2.44
466	32.74	9	1.50
468	33.79	11	1.80
472	35.55	10	1.41
474	38.49	19	0.97
477	37.41	9	1.71
480	40.61	14	1.09
482	39.55	1	
484	42.70	10	1.25
485	43.88	7	1.25
493	46.87	5	2.59
494	48.88	14	1.86
495	50.19	11	1.86
496	47.37	9	1.10
497	42.97	4	4.39
498	45.82	3	2.15

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Table S2. Oceanic anoxic events in the Phanerozoic.OAE, oceanic anoxic event; LC, late Cambrian; FF, Frasnian-Famennian; ET, Early Triassic; HS, Hettangian-Sinemurian; TO, Toarcian; K, Cretaceous; PE, Paleocene-Eocene.

OAEs	Age	Redox condition	Locations	References
PE-OAE	Paleocene-Eocene boundary	anoxic	Turkmenistan	(Gavrilov et al., 1997)
PE-OAE	Paleocene-Eocene boundary	anoxic	Portugal	(Dickson et al., 2014)
PE-OAE	Paleocene-Eocene boundary	anoxic	Turkmenistan	(Speijer et al., 1997)
PE-OAE	Paleocene-Eocene boundary	anoxic	Egypt	(Speijer et al., 1997)
PE-OAE	Paleocene-Eocene boundary	anoxic	ODP Site 302, Arctic Ocean	(Stein et al., 2006)
PE-OAE	Paleocene-Eocene boundary	anoxic	ODP Site 302, Arctic Ocean	(Sluijs et al., 2006)
PE-OAE	Paleocene-Eocene boundary	anoxic	ODP Site 302, Arctic Ocean	(Sluijs et al., 2008)
PE-OAE	Paleocene-Eocene boundary	euxinic	Gulf of Mexico, USA	(Sluijs et al., 2014)
PE-OAE	Paleocene-Eocene boundary	anoxic	Greece	(Khozyem et al., 2015)
K-OAE3	late Santonian-Maastrichtian, Cretaceous	anoxic	Israel	(Jenkyns, 1980)
K-OAE3	Santonian, Cretaceous	anoxic	south Alps	(Jenkyns, 1980)
K-OAE3	Coniacian-Santonian, Cretaceous	euxinic	equatorial Atlantic	(Wagner et al., 2004)
K-OAE3	Coniacian-Santonian, Cretaceous	anoxic	Venezuela	(Rey et al., 2004)
K-OAE3	Coniacian, Cretaceous	anoxic	East Asian	(Jones et al., 2018)
K-OAE3	Coniacian-Santonian, Cretaceous	anoxic	Morocco	(Prauss, 2015)
K-OAE3	Coniacian, Cretaceous	anoxic	USA	(Lowery et al., 2017)
K-OAE3	Coniacian, Cretaceous	anoxic	USA	(Tessin et al., 2016)
K-OAE2	Turonian, Cretaceous	anoxic	Nigeria	(Jenkyns, 1980)
K-OAE2	Turonian, Cretaceous	anoxic	Venezuela	(Jenkyns, 1980)
K-OAE2	early Turonian, Cretaceous	anoxic	England	(Jenkyns, 1980)
K-OAE2	early Turonian, Cretaceous	anoxic	Tunisia	(Jenkyns, 1980)
K-OAE2	early Turonian, Cretaceous	anoxic	Polish Carpathians	(Jenkyns, 1980)
K-OAE2	early Turonian, Cretaceous	anoxic	Umbrian Apennines	(Jenkyns, 1980)
K-OAE2	late Cenomanian, Cretaceous	anoxic	Bonarelli, Italy	(Kuroda et al., 2007)
K-OAE2	late Cenomanian, Cretaceous	euxinic	North Atlantic basin	(Kuypers et al., 2002)
K-OAE2	late Cenomanian-Coniacian, Cretaceous	anoxic	Sicily	(Jenkyns, 1980)
K-OAE2	late Cenomanian-early Coniacian, Cretaceous	anoxic	Morocco	(Jenkyns, 1980)
K-OAE2	late Cenomanian-early Turonian, Cretaceous	anoxic	west Interior, USA	(Jenkyns, 1980)
K-OAE2	late Cenomanian-early Turonian, Cretaceous	anoxic	Subbetic	(Jenkyns, 1980)
K-OAE2	Cenomanian-Coniacian	anoxic	Trinidad	(Jenkyns, 1980)
K-OAE2	Cenomanian, Turonian, Cretaceous	anoxic	Globally distributed	(Schlanger and Jenkyns, 1976)
K-OAE2	Cenomanian-Turonian boundary, Cretaceous	anoxic	Western Interior, USA	(Bowman and Bralower, 2005)
K-OAE2	Cenomanian-Turonian boundary, Cretaceous	anoxic	New Jersey, USA	(Bowman and Bralower, 2005)
K-OAE2	Cenomanian-Turonian boundary, Cretaceous	anoxic	Gubbio, Italy	(Erba, 2004)
K-OAE2	Cenomanian-Turonian boundary, Cretaceous	anoxic	Demerara Rise, North Atlantic	(Erbacher et al., 2005)
K-OAE2	Cenomanian-Turonian boundary, Cretaceous	anoxic	Eastbourne, UK	(Gale et al., 1993)

K-OAE2	Cenomanian-Turonian boundary, Cretaceous	anoxic	Hokkaido, Japan	(Hasegawa and Saito, 1993)
K-OAE2	Cenomanian-Turonian boundary, Cretaceous	euxinic	Eastbourne, UK	(Owens et al., 2013)
K-OAE2	Cenomanian-Turonian boundary, Cretaceous	euxinic	Trunch, UK	(Owens et al., 2013)
K-OAE2	Cenomanian-Turonian boundary, Cretaceous	euxinic	South Ferriby, UK	(Owens et al., 2013)
K-OAE2	Cenomanian-Turonian boundary, Cretaceous	euxinic	Raia del Pedale, Italy	(Owens et al., 2013)
K-OAE2	Cenomanian-Turonian boundary, Cretaceous	euxinic	North Atlantic Ocean	(Pancost et al., 2004)
K-OAE2	Cenomanian-Turonian boundary, Cretaceous	euxinic	North Atlantic Ocean	(Sinninghe Damsté and Köster, 1998)
K-OAE2	Cenomanian-Turonian boundary, Cretaceous	anoxic	Bonarelli, Italy	(Turgeon and Creaser, 2008)
K-OAE2	Cenomanian, Cretaceous	anoxic	Eastbourne, England	(Erba, 2004)
K-OAE2	Cenomanian, Cretaceous	anoxic	North Sea	(Jenkyns, 1980)
K-OAE2	Cenomanian, Cretaceous	anoxic	California, USA	(Jenkyns, 1980)
K-OAE1	late Albian-early Coniacian, Cretaceous	anoxic	Western Australia	(Jenkyns, 1980)
K-OAE1	late Albian, Cretaceous	anoxic	Globally distributed	(Erba, 2004)
K-OAE1	late Albian, Cretaceous	anoxic	west Interior, USA	(Jenkyns, 1980)
K-OAE1	late Albian, Cretaceous	anoxic	south Alps	(Jenkyns, 1980)
K-OAE1	Albian, Cretaceous	anoxic	Peru	(Jenkyns, 1980)
K-OAE1	Albian, Cretaceous	anoxic	Polish Carpathians	(Jenkyns, 1980)
K-OAE1	Albian, Cretaceous	anoxic	central Pacific	(Wilson and Norris, 2001)
K-OAE1	Albian, Cretaceous	anoxic	Western Australia	(Wilson and Norris, 2001)
K-OAE1	Albian, Cretaceous	anoxic	South Atlantic	(Wilson and Norris, 2001)
K-OAE1	Albian, Cretaceous	anoxic	Italy	(Wilson and Norris, 2001)
K-OAE1	Albian, Cretaceous	anoxic	Germany	(Wilson and Norris, 2001)
K-OAE1	Albian, Cretaceous	anoxic	Spain	(Wilson and Norris, 2001)
K-OAE1	Albian, Cretaceous	anoxic	France	(Wilson and Norris, 2001)
K-OAE1	Albian, Cretaceous	anoxic	UK	(Wilson and Norris, 2001)
K-OAE1	Albian, Cretaceous	anoxic	west USA	(Wilson and Norris, 2001)
K-OAE1	Albian, Cretaceous	anoxic	North Atlantic	(Wilson and Norris, 2001)
K-OAE1	Albian, Cretaceous	anoxic	Mexico	(Wilson and Norris, 2001)
K-OAE1	Albian, Cretaceous	anoxic	Bahamas	(Wilson and Norris, 2001)
K-OAE1	Albian, Cretaceous	anoxic	Cuba	(Wilson and Norris, 2001)
K-OAE1	Albian, Cretaceous	anoxic	Venezuela	(Wilson and Norris, 2001)
K-OAE1	Albian, Cretaceous	anoxic	Colombia	(Wilson and Norris, 2001)
K-OAE1	Albian, Cretaceous	anoxic	Brazil	(Wilson and Norris, 2001)
K-OAE1	Albian-Cenomanian, Cretaceous	anoxic	Briançonnais	(Jenkyns, 1980)
K-OAE1	Albian-Cenomanian, Cretaceous	anoxic	Ligurian Apennines, Italy	(Jenkyns, 1980)
K-OAE1	Aptian, Albian, Cretaceous	anoxic	Maritime Alps	(Jenkyns, 1980)
K-OAE1	Aptian, Albian, Cretaceous	anoxic	Balearic Islands	(Jenkyns, 1980)
K-OAE1	Aptian, Albian, Cretaceous	anoxic	Subbetic	(Jenkyns, 1980)
K-OAE1	Aptian, Albian, Cretaceous	anoxic	Umbrian Apennines	(Jenkyns, 1980)
K-OAE1	Aptian, Albian, Cretaceous	anoxic	Globally distributed	(Schlanger and Jenkyns, 1976)
K-OAE1	Aptian, Cretaceous	anoxic	Cismon, Italy	(Méhay et al., 2009)
K-OAE1	Aptian, Cretaceous	euxinic	Marche-Umbria, Italy	(Pancost et al., 2004)

K-OAE1	early Aptian, Cretaceous	anoxic	Globally distributed	(Erba, 2004)
K-OAE1	Barremian-early Aptian, Cretaceous	anoxic	northwestern Germany	(Jenkyns, 1980)
	late Barremian, Cretaceous	anoxic	Umbrian Apennines	(Jenkyns, 1980)
	late Barremian, Cretaceous	anoxic	south Alps	(Jenkyns, 1980)
	Barremian, Cretaceous	anoxic	North Alps	(Jenkyns, 1980)
	Tithonian, Jurassic	anoxic-euxinic	Neuquén Basin, Argentina	(Gouiric-Cavalli and Clone, 2015)
	Kimmeridgian, Jurassic	anoxic	Kimmeridge Bay, UK	(Raiswell et al., 2001)
	Kimmeridgian, Jurassic	dysoxic	Boulonnais, France	(Wignall and Newton, 2001)
	Callovian, Jurassic	dysoxic-anoxic	southcentral England, UK	(Kenig et al., 2004)
	Callovian, Jurassic	dysoxic	southcentral England, UK	(Hudson and Martill, 1991)
	late Bajocian-early Kimmeridgian, Jurassic	dysoxic-anoxic	northern Tibet, China	(Chen et al., 2014)
	late Bajocian, Bathonian, Jurassic	oxic	Polish Jura, Poland	(Zatoń et al., 2009)
	Aalenian, Bajocian, Jurassic	dysoxic-anoxic	PieninyKlippen Basin, Poland	(Tyszka and Kaminski, 1995)
	Aalenian, Bajocian, Jurassic	dysoxic-anoxic	PieninyKlippen Basin, Poland	(Tyszka, 1994)
TO-OAE	early Toarcian, Jurassic	anoxic	Neuquén Basin, Argentina	(Al-Suwaidi et al., 2010)
TO-OAE	early Toarcian, Jurassic	anoxic	England, Germany	(Bailey et al., 2003)
TO-OAE	early Toarcian, Jurassic	euxinic	HaidaGwaii, Canada	(Caruthers et al., 2011)
TO-OAE	early Toarcian, Jurassic	anoxic	northwestern Europe	(Hesselbo et al., 2000)
TO-OAE	early Toarcian, Jurassic	anoxic	Lusitanian Basin, Portugal	(Hesselbo et al., 2007)
TO-OAE	early Toarcian, Jurassic	anoxic	western Canada	(Jenkyns, 1988)
TO-OAE	early Toarcian, Jurassic	anoxic	Arctic Slope	(Jenkyns, 1988)
TO-OAE	early Toarcian, Jurassic	anoxic	Japan	(Jenkyns, 1988)
TO-OAE	early Toarcian, Jurassic	anoxic	Madagascar	(Jenkyns, 1988)
TO-OAE	early Toarcian, Jurassic	anoxic	Argentina	(Jenkyns, 1988)
TO-OAE	early Toarcian, Jurassic	anoxic	western Australia	(Jenkyns, 1988)
TO-OAE	early Toarcian, Jurassic	anoxic	Peloponnese, Greece	(Kafousia et al., 2011)
TO-OAE	early Toarcian, Jurassic	anoxic	Yorkshire, UK	(Kemp et al., 2005)
TO-OAE	early Toarcian, Jurassic	anoxic	Yorkshire, UK	(Little et al., 2010)
TO-OAE	early Toarcian, Jurassic	Euxinic	Marche-Umbria, Italy	(Pancost et al., 2004)
TO-OAE	early Toarcian, Jurassic	euxinic	Valdorbria, Italy	(Sabatino et al., 2009)
TO-OAE	early Toarcian, Jurassic	euxinic	Dotternhausen, Germany	(Schootbrugge et al., 2013)
TO-OAE	early Toarcian, Jurassic	anoxic	Kelimayar River, Russia	(Suan et al., 2011)
TO-OAE	early Toarcian, Jurassic	anoxic-euxinic	Mino-Tamba, Japan	(Wignall et al., 2010)
TO-OAE	late Pliensbachian-early Toarcian, Jurassic	dysoxic-anoxic	Inuyama, Japan	(Sato et al., 2012)
HS-OAE	late Sinemurian, Jurassic	dysoxic-anoxic	Lusitanian Basin, Portugal	(Boussaha et al., 2014)
HS-OAE	early Sinemurian, Jurassic	dysoxic-anoxic	Apley Barn, UK	(Wignall and Hallam, 1991)
HS-OAE	Hettangian and Sinemurian, Jurassic	dysoxic-anoxic	Woorset Coast, UK	(Wignall and Hallam, 1991)
HS-OAE	Hettangian and Sinemurian, Jurassic	dysoxic-anoxic	stowell Park, UK	(Wignall and Hallam, 1991)
HS-OAE	Hettangian and Sinemurian, Jurassic	dysoxic-anoxic	north Gloucester, UK	(Wignall and Hallam, 1991)
HS-OAE	Hettangian and Sinemurian, Jurassic	dysoxic-anoxic	Warwick, UK	(Wignall and Hallam, 1991)
HS-OAE	Hettangian and Sinemurian, Jurassic	dysoxic-anoxic	west Scotland, UK	(Wignall and Hallam, 1991)
HS-OAE	Hettangian and early Sinemurian, Jurassic	dysoxic-anoxic	Mingolsheim, Germany	(Quan et al., 2008)
HS-OAE	Hettangian and early Sinemurian, Jurassic	dysoxic-anoxic	north Somerset, UK	(Wignall and Hallam, 1991)

HS-OAE	Hettangian, Jurassic	dysoxic	British Columbia, Canada	(Kasprak et al., 2011)
HS-OAE	Hettangian, Jurassic	euxinic	Mingolsheim core, Germany	(Schootbrugge et al., 2013)
HS-OAE	early Hettangian, Jurassic	euxinic	Rosswinkel, Luxemburg	(Ricoz et al., 2010; Ricoz et al., 2012)
HS-OAE	early Hettangian, Jurassic	euxinic	Mariental, Germany	(Ricoz et al., 2010; Ricoz et al., 2012)
HS-OAE	early Hettangian, Jurassic	euxinic	Mingolsheim, Germany	(Ricoz et al., 2010)
HS-OAE	early Hettangian, Jurassic	dysoxic-anoxic	south Wales, UK	(Wignall and Hallam, 1991)
HS-OAE	early Hettangian, Jurassic	dysoxic-anoxic	Humber, UK	(Wignall and Hallam, 1991)
HS-OAE	early Hettangian, Jurassic	dysoxic-anoxic	north Yorkshire, UK	(Wignall and Hallam, 1991)
HS-OAE	early Hettangian, Jurassic	dysoxic-anoxic	Doniford, UK	(Clémence et al., 2010)
HS-OAE	Rhaetian-Hettangian boundary, TJ boundary	dysoxic-anoxic	Apennine basin, Italy	(Ciarapica, 2007)
HS-OAE	Rhaetian-Hettangian boundary, TJ boundary	anoxic	British Columbia, Canada	(Williford et al., 2009)
HS-OAE	Rhaetian-Hettangian boundary, TJ boundary	dysoxic-anoxic	England	(Hallam, 1995)
HS-OAE	Rhaetian-Hettangian boundary, TJ boundary	dysoxic-anoxic	Germany	(Hallam, 1995)
ET-OAE	Induan, Olenekian, Triassic	anoxic-euxinic	Arctic Canada	(Grasby et al., 2013)
ET-OAE	Induan, Olenekian, Triassic	anoxic	Qingyan, South China	(Song et al., 2012b)
ET-OAE	Induan, Olenekian, Triassic	anoxic	Meishan, South China	(Song et al., 2012b)
ET-OAE	Induan, Olenekian, Triassic	anoxic	Guandao, South China	(Song et al., 2012b)
ET-OAE	Induan, Olenekian, Triassic	anoxic	South China	(Song et al., 2013)
ET-OAE	Induan, Olenekian, Triassic	anoxic-euxinic	South China	(Song et al., 2014)
ET-OAE	Induan, Olenekian, Triassic	dysoxic-euxinic	Mino-Tamba, Japan	(Wignall et al., 2010)
ET-OAE	Induan, Triassic	anoxic	Globally	(Wignall and Twitchett, 2002)
ET-OAE	early Induan, Triassic	anoxic	Salt Range	(Wignall and Hallam, 1993)
ET-OAE	early Induan, Triassic	anoxic	Pakistan	(Wignall and Hallam, 1993)
ET-OAE	early Induan, Triassic	anoxic	southeast China	(Wignall and Hallam, 1993)
ET-OAE	end-Changhsingian-early Induan, Triassic	anoxic-euxinic	Nhi Tao, Vietnam	(Algeo et al., 2007; Algeo et al., 2008)
ET-OAE	end-Changhsingian-early Induan, Triassic	dysoxic-euxinic	Ubara, Japan	(Algeo et al., 2011)
ET-OAE	end-Changhsingian-early Induan, Triassic	dysoxic-euxinic	Gujo-Hachiman, Japan	(Algeo et al., 2011)
ET-OAE	end-Changhsingian-early Induan, Triassic	dysoxic-euxinic	Spitsbergen	(Bond and Wignall, 2010)
ET-OAE	end-Changhsingian-early Induan, Triassic	dysoxic-euxinic	Greenland	(Bond and Wignall, 2010)
ET-OAE	end-Changhsingian-early Induan, Triassic	dysoxic-euxinic	Western Australia	(Bond and Wignall, 2010)
ET-OAE	end-Changhsingian-early Induan, Triassic	dysoxic-anoxic	Italy	(Bond and Wignall, 2010)
ET-OAE	end-Changhsingian-early Induan, Triassic	dysoxic-euxinic	South China	(Bond and Wignall, 2010)
ET-OAE	end-Changhsingian-early Induan, Triassic	anoxic-euxinic	Svalbard, Norway	(Dustira et al., 2013)
ET-OAE	end-Changhsingian-early Induan, Triassic	anoxic	Middle East	(Ehrenberg et al., 2008)
ET-OAE	end-Changhsingian-early Induan, Triassic	euxinic	Perth, Western Australia	(Grice et al., 2005)
ET-OAE	end-Changhsingian-early Induan, Triassic	euxinic	Meishan, South China	(Grice et al., 2005)
ET-OAE	end-Changhsingian-early Induan, Triassic	anoxic	Julfra, Iran	(Kakuwa and Matsumoto, 2006)
ET-OAE	end-Changhsingian-early Induan, Triassic	dysoxic	Laolongdong, South China	(Liao et al., 2010)
ET-OAE	end-Changhsingian-early Induan, Triassic	anoxic	Meishan, South China	(Shen et al., 2007)
ET-OAE	end-Changhsingian-early Induan, Triassic	euxinic	South China	(Song et al., 2012a)

ET-OAE	end-Changhsingian-early Induan, Triassic	anoxic-euxinic	northern Italy	(Wignall and Hallam, 1992)
ET-OAE	end-Changhsingian-early Induan, Triassic	anoxic-euxinic	western USA	(Wignall and Hallam, 1992)
ET-OAE	end-Changhsingian-early Induan, Triassic	anoxic	KappStarostin, Spitsbergen	(Wignall and Twitchett, 1996)
ET-OAE	end-Changhsingian-early Induan, Triassic	anoxic	P. San Pellegrino, Italy	(Wignall and Twitchett, 1996)
ET-OAE	end-Changhsingian-early Induan, Triassic	anoxic	Tesero, Italy	(Wignall and Twitchett, 1996)
ET-OAE	end-Changhsingian-early Induan, Triassic	anoxic	Bulla, Italy	(Wignall and Twitchett, 1996)
ET-OAE	end-Changhsingian-early Induan, Triassic	anoxic	Siusi, Italy	(Wignall and Twitchett, 1996)
ET-OAE	end-Changhsingian-early Induan, Triassic	anoxic	Medvodje, Slovenia	(Wignall and Twitchett, 1996)
ET-OAE	end-Changhsingian-early Induan, Triassic	anoxic	Guryul Ravine, Kashmir	(Wignall et al., 2005)
ET-OAE	late Changhsingian-Olenekian, Triassic	anoxic	southwest Japan	(Isozaki, 1997)
ET-OAE	late Changhsingian-Olenekian, Triassic	anoxic	British Columbia	(Isozaki, 1997)
FF-OAE	Frasnian-Famennian boundary, Devonian	anoxic	Belgium	(Claeys et al., 1996)
FF-OAE	Frasnian-Famennian boundary, Devonian	anoxic	Kowala, Poland	(Girard and Lécuyer, 2002)
FF-OAE	Frasnian-Famennian boundary, Devonian	euxinic	Kowala, Poland	(Joachimski et al., 2001)
FF-OAE	Frasnian-Famennian boundary, Devonian	anoxic	La Serre, France	(Riquier et al., 2005)
FF-OAE	Frasnian-Famennian boundary, Devonian	anoxic	Montagne Noire, France	(Tribouillard et al., 2004)
FF-OAE	end-Frasnian, Devonian	euxinic	Great Basin, USA	(Bond and Wignall, 2005)
FF-OAE	late Frasnian-end-Frasnian, Devonian	dysoxic-euxinic	Steinbruch Benner, Germany	(Bond et al., 2004)
FF-OAE	late Frasnian-end-Frasnian, Devonian	dysoxic-euxinic	Kowala, Poland	(Bond et al., 2004)
FF-OAE	late Frasnian-end-Frasnian, Devonian	dysoxic	PsieGórki, Poland	(Bond et al., 2004)
FF-OAE	late Frasnian-end-Frasnian, Devonian	dysoxic-euxinic	Plucki, Poland	(Bond et al., 2004)
FF-OAE	late Frasnian-end-Frasnian, Devonian	dysoxic	La Serre, France	(Bond et al., 2004)
FF-OAE	late Frasnian-end-Frasnian, Devonian	anoxic	Alberta, Canada	(Bond et al., 2013)
FF-OAE	late Frasnian-end-Frasnian, Devonian	dysoxic-anoxic	Aeketal, Germany	(Riquier et al., 2005)
FF-OAE	late Frasnian-end-Frasnian, Devonian	dysoxic-anoxic	Bou-Ounebdou, Morocco	(Riquier et al., 2005)
FF-OAE	late Frasnian-end-Frasnian, Devonian	dysoxic-anoxic	Anajdam, Morocco	(Riquier et al., 2005)
FF-OAE	late Frasnian, Devonian	dysoxic	Coumiac, France	(Bond et al., 2004)
FF-OAE	late Frasnian, Devonian	anoxic	France, Germany, Austria	(Joachimski and Buggisch, 1993)
FF-OAE	Frasnian, Devonian	anoxic	Great Basin, USA	(Bratton et al., 1999)
FF-OAE	early Frasnian, Devonian	anoxic	Ahnet Basin, Algeria	(Lüning et al., 2004)
FF-OAE	Middle Devonian-Early Carboniferous	euxinic	Michigan Basin, USA	(Brown and Kenig, 2004)
LC-OAE	Paibian, Cambrian	euxinic	Great Basin, USA	(Gill et al., 2011)
LC-OAE	Paibian, Cambrian	euxinic	Missouri, USA	(Gill et al., 2011)
LC-OAE	Paibian, Cambrian	euxinic	Queensland, Australia	(Gill et al., 2011)
LC-OAE	Paibian, Cambrian	euxinic	Sweden	(Gill et al., 2011)
LC-OAE	Paibian, Cambrian	anoxic	Iowa, USA	(Erick et al., 2011)
LC-OAE	Paibian, Cambrian	anoxic	Utah, USA	(Erick et al., 2011)

Table S3. Sea surface temperatures and atmospheric CO₂ concentrations per ten million years in the Phanerozoic. Atmospheric CO₂ concentrations are from the GEOCARBSULF model (Royer et al., 2014).

Age (Ma)	Mean temperature(°C)	pCO ₂ (ppm)
500	46.59	4047
490	48.65	3513
480	40.83	3171
470	35.14	2837
460	32.14	2435
450	27.94	2536
440	28.25	2600
430	28.38	1957
420	30.68	2550
410	30.85	2612
400	27.28	2773
390	25.74	1415
380	28.22	1647
370	32.32	1075
360	28.68	786
350	23.61	279
340	18.01	369
330	13.90	292
320	11.34	318
310	18.26	334
300	17.90	341
290	15.28	408
280	15.37	396
270	17.87	338
260	21.18	390
250	24.50	1599
240	26.60	1437
230	22.47	1325
220	22.07	906
210	22.79	788
200	17.86	421
190	21.06	486
180	23.56	360
170	23.71	268
160	20.55	292
150	19.68	318
140	17.72	400
130	21.16	411
120	22.06	363

110	20.59	348
100	25.06	290
90	30.59	193
80	20.47	187
70	16.84	203
60	17.86	249
50	21.80	283
40	17.80	234
30	17.97	219
20	17.52	242
10	16.63	271
0	16.88	269

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