

Table S1. Relative abundances of clay minerals from Ronov et al. (1990) as percentages of the total clays for individual time intervals through the Phanerozoic and late Precambrian.

Name ^a	Age ^b	Label	Kaolinite	Illite	Montmor.	Chlorite	Name ^c
L. Riphean	1300	R1	17.5	68.4	8.8	5.3	Ectasian Period
M. Riphean	1100	R2	16.4	78.7	3.3	1.6	Stenian Period
U. Riphean	925	R3	16.4	70.5	8.2	4.9	Tonian Period
Vendian	554.5	V	29.9	47.8	14.9	7.5	Vendian
Cambrian	515.15	C	16.1	79.0	0.0	4.8	Cambrian
Ordovician	466	O	19.6	60.8	19.6	0.0	Ordovician
Silurian	429.85	S	0.0	75.5	9.4	15.1	Silurian
M. Devonian	391.4	D2	25.4	52.5	16.9	5.1	M. Devonian
Frasnian	379.9	D3f	33.9	49.2	16.9	0.0	Frasnian
Famennian	366.85	D3fm	20.0	60.0	20.0	0.0	Famennian
L. Carboniferous	343.75	C1	49.2	34.4	16.4	0.0	L.+M. Miss.
M. Carboniferous	320	C2	22.4	55.2	14.9	7.5	U. Miss. + L. Penn.
Ufa Stage	271.6	P2uf	0.0	63.0	9.3	27.8	Ufimian Stage
Kazanian Stage	269.3	P2kaz	11.9	40.5	35.7	11.9	Kazanian Stage
Tatar Stage	258.4	P2tat	0.0	51.0	39.2	9.8	Tatarian Stage
Triassic	225.3	T	17.2	17.2	51.7	13.8	Triassic
L. Jurassic	187.6	J1	39.0	41.6	13.0	6.5	L. Jurassic
M. Jurassic	168.4	J2	35.7	28.6	28.6	7.1	M. Jurassic
U. Jurassic	153.35	J3	40.3	30.6	24.2	4.8	U. Jurassic
L. Cretaceous	122.55	K1	41.7	20.0	33.3	5.0	L. Cretaceous
U. Cretaceous	82.55	K2	20.0	25.0	50.0	5.0	U. Cretaceous
Paleocene	60.65	P	33.3	33.3	33.3	0.0	Paleocene
L.+M. Eocene	46.5	P2(1+2)	70.6	9.8	19.6	0.0	L. + M. Eocene
U. Eocene	35.55	P23	25.9	22.4	51.7	0.0	U. Eocene
Oligocene	28.45	P3	23.1	26.2	50.8	0.0	Oligocene
Miocene	14.15	N1	15.4	15.4	69.2	0.0	Miocene
Pliocene	4.05	N2	15.4	23.1	56.9	4.6	Pliocene
Quaternary	1.4	Q	23.3	21.7	53.3	1.7	Quaternary

a. Geologic time intervals listed by Ronov et al. (1990).

b. Age in Ma.

c. Geologic time intervals from Gradstein et al. (2004)

Table S2. Values of the atmospheric O₂ and CO₂ levels from the GEOCARBSULF model of Berner (2006, 2009).

Age ^a	% O ₂ ^b	R(CO ₂) ^c	Age	% O ₂	R(CO ₂)
560	20.3	11.3			
550	20.4	12.9	270	31.9	2.01
540	16.7	16.0	260	30.8	1.56
530	18.9	17.5	250	23.0	1.70
520	21.6	18.9	240	18.1	5.71
510	21.3	17.2	230	19.5	3.27
500	18.1	15.0	220	22.7	3.49

490	20.7	9.81	210	22.7	2.39
480	18.5	12.1	200	19.2	3.55
470	15.5	10.8	190	14.6	2.72
460	17.0	8.18	180	13.8	4.40
450	18.0	8.01	170	14.4	3.67
440	20.0	9.32	160	15.3	2.39
430	21.8	11.4	150	15.9	2.58
420	23.8	13.9	140	14.6	2.90
410	26.3	11.8	130	16.2	4.56
400	22.3	12.5	120	19.3	6.03
390	19.0	7.79	110	21.3	4.93
380	17.6	9.19	100	22.0	6.30
370	18.4	12.8	90	22.1	6.27
360	20.7	7.42	80	22.1	4.08
350	23.0	2.39	70	21.9	3.77
340	23.7	1.68	60	21.7	3.48
330	22.2	1.73	50	21.5	2.68
320	22.2	1.80	40	22.2	2.41
310	26.1	1.70	30	22.8	1.42
300	29.5	2.14	20	22.6	1.06
290	31.5	2.40	10	21.7	1.04
280	32.0	11.3	0	20.2	1.11

a. Age in Ma.

b. Atmospheric O₂ level in percent from the GEOCARBSULF model (Berner, 2009).

c. Atmospheric CO₂ level from the GEOCARBSULF model (Berner, 2006), where R(CO₂) refers to the ratio of CO₂ in the past to that at present.

Table S3. Relative abundances of clay minerals from Ronov et al. (1990) and smoothed atmospheric O₂ and CO₂ levels from GEOCARBSULF at the same time intervals used for statistical analyses (see text).

Name ^a .	Age ^b .	Label	Kaolinite	Illite	Montmor.	Chlorite	Name ^c .
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Quaternary	1.4	Q	23.3	21.7	53.3	1.7	Quaternary

a. Geologic time intervals listed by Ronov et al. (1990).

b. Age in Ma.

c. Geologic time intervals from Gradstein et al. (2004)

d. Atmospheric O₂ level in percent at the same time interval as the clay abundances.

e. Atmospheric CO₂ level at the same time interval as the clay abundances. R(CO₂) refers to the ratio of CO₂ in the past to that at present.

Table S4. Summary of the correlations between clay mineral relative abundances and atmospheric O₂ and CO₂ levels. Values cited are Pearson product-moment correlation coefficients (PMCC).

	Kaolinite	Illite	Smectite	Chlorite	% O ₂
Kaolinite Group					
Illite Group	-0.497				
Smectite Group	-0.154	-0.742			
Chlorite Group	-0.551	0.362	-0.254		
% O ₂	-0.498	0.131	0.115	0.510	
R(CO ₂)	-0.137	0.716	-0.617	-0.035	-0.273