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Appendix from N. D. Sheldon et al., "Continental Climatic and Weathering Response to the Eocene-Oligocene Transition"

(J. Geol., vol. 120, no. 2, p. 227)

Supplementary Tables and Figures

Table A1. Weathering Ratios

Epoch, sample	Meter level	CIA	ΔW	ΔW[a]	Ti/Al	MAT (°C)	MAT (°C)[a]
Eocene:							
MAI 4	115.5	12.5	−1.8	...	.06	11.4	...
MAI 5	123.0	10.0	−4.4	...	.08	8.8	...
MAI 6	126.3	15.1	.8	...	.07	8.8	...
MAI 7	125.7	25.5	11.2	...	.06	12.0	...
MAI 8	124.7	10.0	−4.3	.3	.06	11.0	10.4
MAI 9	132.7	18.7	4.4	1.5	.06	10.9	10.3
MAI 11	155.5	10.5	−3.8	1.6	.07	7.8	10.1
MAI 12	160.0	9.1	−5.2	.4	.07	10.4	10.4
MAI 13	180.3	21.9	7.6	−.3	.06	13.3	10.7
MAI 14	181.5	13.3	−1.1	.4	.06	13.5	11.2
MAI 16	193.2	18.1	3.8	.3	.08	8.7	10.7
MAI 18	206.5	21.8	7.5	2.5	.06	11.6	11.5
MAI 22	210.9	19.8	5.5	4.7	.06	11.4	11.7
MAI 23	211.0	23.9	9.5	5.0	.06	11.7	11.4
MAI 24	211.1	22.1	7.8	6.8	.06	12.3	11.1
MAI 25	211.1	22.9	8.6	7.8	.06	11.9	11.8
MAI 26	234.0	11.0	−3.3	5.6	.07	10.0	11.5
MAI 27	235.1	6.9	−7.4	3.0	.07	10.4	11.3
MAI 28	236.1	19.2	4.8	2.1	.07	10.3	11.0
MAI 29	244.7	22.4	8.1	2.2	.06	10.5	10.6
MAI 30	247.8	18.2	3.9	1.2	.06	10.3	10.3
MAI 33	252.0	27.9	13.6	4.6	.07	10.5	10.4
MAI 34	253.5	10.1	−4.2	5.2	.06	12.3	10.8
MAI 36	260.8	8.2	−6.1	3.1	.06	11.9	11.1
Oligocene:							
MAI 37	269.0	21.0	6.7	2.8	.06	11.9	11.4
MAI 38	270.0	5.5	−8.8	.3	.06	10.3	11.4
MAI 39	273.0	10.9	−3.4	−3.2	.06	12.5	11.8
MAI 40	274.4	9.3	−5.0	−3.3	.06	10.4	11.4
MAI 41	275.6	11.7	−2.6	−2.6	.07	10.1	11.1
MAI 43	287.2	16.4	2.1	−3.5	.06	10.0	10.7
MAI 44	297.4	9.7	−4.6	−2.7	.07	9.5	10.5
MAI 45	307.7	18.6	4.3	−1.2	.07	9.4	9.9
MAI 46	310.0	10.5	−3.8	−.9	.06	11.0	10.0
MAI 47	311.4	5.5	−8.8	−2.2	.07	8.2	9.6
MAI 48	314.3	16.9	2.6	−2.1	.07	10.5	9.7
MAI 49	325.2	18.9	4.6	−.2	.07	9.8	9.8
MAI 50	325.9	5.6	−8.7	−2.8	.07	10.5	10.0
MAI 51	332.3	7.5	−6.8	−3.4	.07	10.5	9.9
MAI 52	335.0	17.6	3.3	−1.0	.07	10.0	10.3
MAI 2	337.0	10.9	−3.5	−2.2	.08	8.3	9.8
MAI 1	338.0	6.7	−7.6	−4.7	.06	13.1	10.5
MAI 54	350.6	3.5	−10.9	−5.1	.05	13.7	11.1
MAI 53	351.3	6.6	−7.7	−5.2	.07	10.2	11.1
MAI 54	361.0	7.9	−6.4	−7.2	.06	13.0	11.7

Note. CIA = chemical index of alteration, ΔW = long-term changes in chemical weathering, MAT = mean annual temperature.

[a]Five-point running average values.

Table A2. Stable Isotope Data

Epoch, sample	Meter level	$\Delta^{13}C$	$\Delta^{18}O$	Bk depth (cm)
Eocene:				
MC 3	122.7	−4.54	−6.52	45
MC 4	125.9	−5.12	−6.53	55
MC 5	155	−4.79	−5.74	35
MC 6	158.5	−4.72	−6.33	Eroded
MC 7	162.3	−6.09	−6.47	Eroded
MC 8	171	−4.65	−6.61	Eroded
MC 9	180.5	−4.78	−6.43	Eroded
MC 10	183.4	−4.92	−6.04	Eroded
MC 11	207.7	−5.46	−5.81	55
MC 12	235.6	−6.51	−6.29	60
MC 13	243.2	−4.52	−5.43	60
MC 14	253	−5.16	−6.61	Eroded
MC 15	259.2	−5.30	−6.17	50
Oligocene:				
MC 16	272.5	−4.95	−5.63	45
MC 2	276	−5.36	−5.91	Eroded
MC 17	293.5	−4.35	−5.24	Eroded
MC 18	305.7	−5.19	−6.95	Eroded
MC 1	312.5	−4.75	−6.53	Eroded
MC 19	329.2	−4.23	−6.14	50
MI 1	330.55	−4.88	−6.47	Eroded
MI 2	336	−4.97	−6.49	Eroded
MI 3	350.75	−4.25	−6.26	Eroded
MI 4	359.5	−4.46	−6.70	Eroded

Note. Samples for which the Bk depth is listed as “eroded” are cases where the completeness of the profile could not be assured, so the Bk depth was not measured. In all cases, the pedogenic nodules were collected at least 30 cm below the top of the remaining profile, regardless of whether a precise Bk depth could be measured.

Table A3. Whole-Rock Geochemical Data (Eocene Samples)

Sample	Meter level	SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	Na_2O	K_2O	TiO_2	P_2O_5
MAI 4	115.5	38.0	10.2	4.0	6.7	37.7	.2	2.6	.5	.1
MAI 5	123	43.2	7.6	2.5	7.5	36.2	.2	2.2	.5	.1
MAI 6	126.3	47.2	8.3	3.9	13.4	24.1	.2	2.3	.5	.1
MAI 7	125.7	45.3	13.1	4.9	13.5	18.9	.2	3.3	.6	.1
MAI 8	124.7	32.5	8.3	2.8	13.9	39.6	.2	2.1	.4	.1
MAI 9	132.7	41.6	10.4	4.9	16.6	23.0	.2	2.7	.5	.1
MAI 11	155.5	49.5	6.9	2.5	7.7	30.8	.2	2.0	.4	.1
MAI 12	160	34.9	8.1	2.7	8.3	43.2	.2	2.1	.4	.1
MAI 13	180.3	37.9	12.8	5.0	17.3	22.9	.2	3.2	.6	.1
MAI 14	181.5	33.8	11.6	3.6	7.5	40.0	.2	2.7	.5	.1
MAI 16	193.2	52.8	8.9	3.2	11.1	20.5	.3	2.4	.6	.1
MAI 18	206.5	42.9	11.8	4.4	15.7	21.2	.3	3.0	.6	.1
MAI 22	210.9	45.5	12.2	4.5	8.4	25.2	.2	3.1	.6	.1
MAI 23	211.02	44.4	12.4	4.6	14.8	19.7	.3	3.1	.6	.1
MAI 24	211.1	41.2	12.4	4.5	16.0	21.9	.3	3.1	.6	.1
MAI 25	211.06	42.6	12.3	4.9	15.5	20.7	.3	3.0	.5	.1
MAI 26	234	40.3	8.7	3.1	7.5	37.3	.2	2.2	.5	.1
MAI 27	235.1	30.4	7.0	3.1	6.3	50.6	.2	1.9	.4	.1
MAI 28	236.1	44.7	10.2	3.8	15.9	21.8	.3	2.6	.5	.1
MAI 29	244.7	47.4	11.2	4.2	13.9	19.4	.3	2.9	.5	.1
MAI 30	247.8	48.7	11.2	3.4	7.1	25.5	.3	3.0	.6	.1
MAI 33	252	51.6	12.2	4.7	12.0	15.1	.3	3.3	.7	.1
MAI 34 A\6	253.5	31.6	9.5	3.5	7.2	45.0	.2	2.4	.4	.1
MAI 36	260.75	27.6	7.9	3.4	11.2	47.2	.2	2.0	.4	.0

Note. Major element oxide values are normalized to 100%; totals less than 100% reflect samples with a minor amount of MnO (<0.1 wt%).

Table A4. Whole-Rock Geochemical Data (Oligocene Samples)

Sample	Meter level	SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	Na_2O	K_2O	TiO_2	P_2O_5
MAI 37	269	41.1	11.8	4.9	15.9	22.2	.2	3.2	.6	.1
MAI 38	270	27.0	6.2	2.0	5.8	56.7	.2	1.8	.3	.1
MAI 39	273	32.6	10.1	4.5	6.1	43.6	.2	2.4	.4	.1
MAI 40	274.4	35.3	8.2	3.5	7.7	42.5	.2	2.1	.4	.1
MAI 41	275.6	40.6	8.9	4.1	7.7	35.4	.2	2.5	.5	.1
MAI 43	287.15	42.5	9.2	3.9	17.0	24.2	.3	2.4	.5	.1
MAI 44	297.4	37.4	7.4	2.5	13.1	36.6	.2	2.2	.4	.1
MAI 45	307.7	47.9	9.5	3.0	15.1	20.9	.2	2.7	.5	.1
MAI 46	310	36.2	9.1	3.6	6.6	41.2	.2	2.4	.5	.1
MAI 47	311.4	32.5	5.0	2.0	12.4	45.8	.2	1.6	.3	.0
MAI 48	314.3	41.3	9.7	3.2	17.7	24.3	.3	2.8	.5	.1
MAI 49	325.2	46.2	9.7	4.4	15.2	21.0	.2	2.6	.5	.1
MAI 50	325.9	27.0	6.3	2.2	4.5	57.6	.2	1.8	.3	.1
MAI 51	332.3	30.1	7.1	2.6	10.9	46.8	.2	1.9	.4	.1
MAI 52	335	44.1	9.7	3.3	16.3	23.0	.3	2.7	.5	.1
MAI 2	337	43.4	6.7	2.8	15.2	29.0	.3	2.1	.4	.1
MAI 1	338	23.2	7.7	2.6	6.8	56.9	.2	2.1	.4	.1
MAI 54	350.6	13.6	4.8	1.6	5.9	72.1	.1	1.5	.2	.1
MAI 53	351.3	27.1	6.1	2.1	16.4	45.6	.2	2.1	.3	.1
MAI 54 (9)	361	25.2	8.2	3.9	8.7	51.3	.1	2.0	.4	.0

Note. Major element oxide values are normalized to 100%; totals less than 100% reflect samples with a minor amount of MnO (<0.1 wt%).

Figure A1. Paleosol features from Ebro Basin paleosols preserved in the Artés Formation. *A*, Depth profile through an Inceptisol-like paleosol. Note that the Bk horizon is ∼40 cm beneath the top of the profile and is dispersed over ∼20 cm within the profile. *B*, Centimeter-scale burrows. Note the redox difference between the oxidized paleosol and the reduced burrow. *C*, Terrestrial gastropod casts. *D*, In situ burrow. As with *B*, there appears to be a redox difference between the burrow and the surrounding paleosol material.

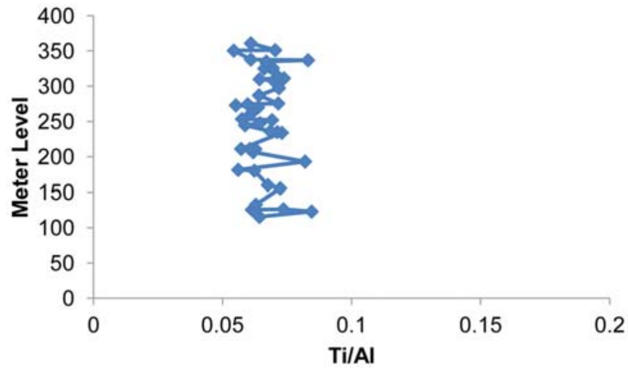

Figure A2. Ti/Al ratio as a function of stratigraphic position. The Eocene-Oligocene boundary is at 264.5 m on the basis of magnetostratigraphy. The consistency of the Ti/Al ratio indicates unchanging sedimentary provenances, and the absolute values of the ratio are consistent with previously reported values for terrigenous clastic material (Sheldon and Tabor 2009).

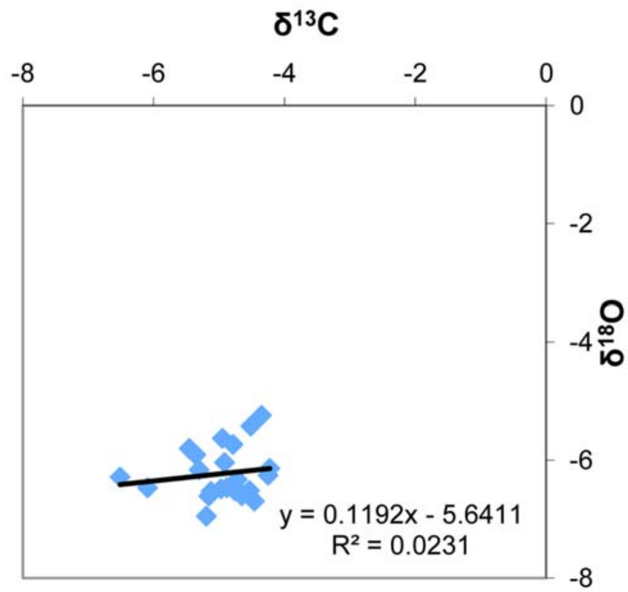

Figure A3. Cross-plot of pedogenic carbonate $\delta^{13}C$ and $\delta^{18}O$ values. There is no relationship between $\delta^{13}C$ and $\delta^{18}O$, which is consistent with samples that have not been diagenetically altered or subject to significant amounts of evaporation (Ufnar et al. 2008).

References Cited Only in the Appendix

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