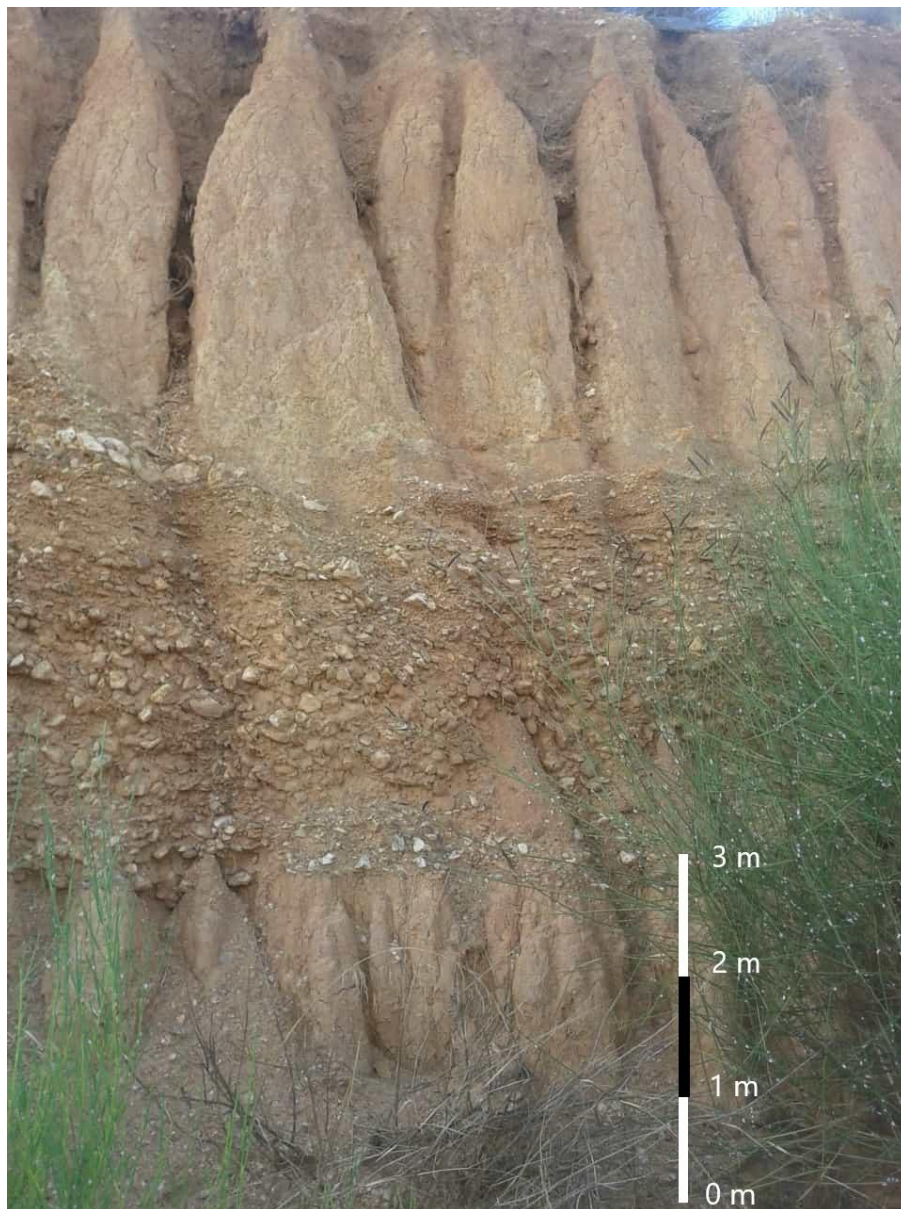


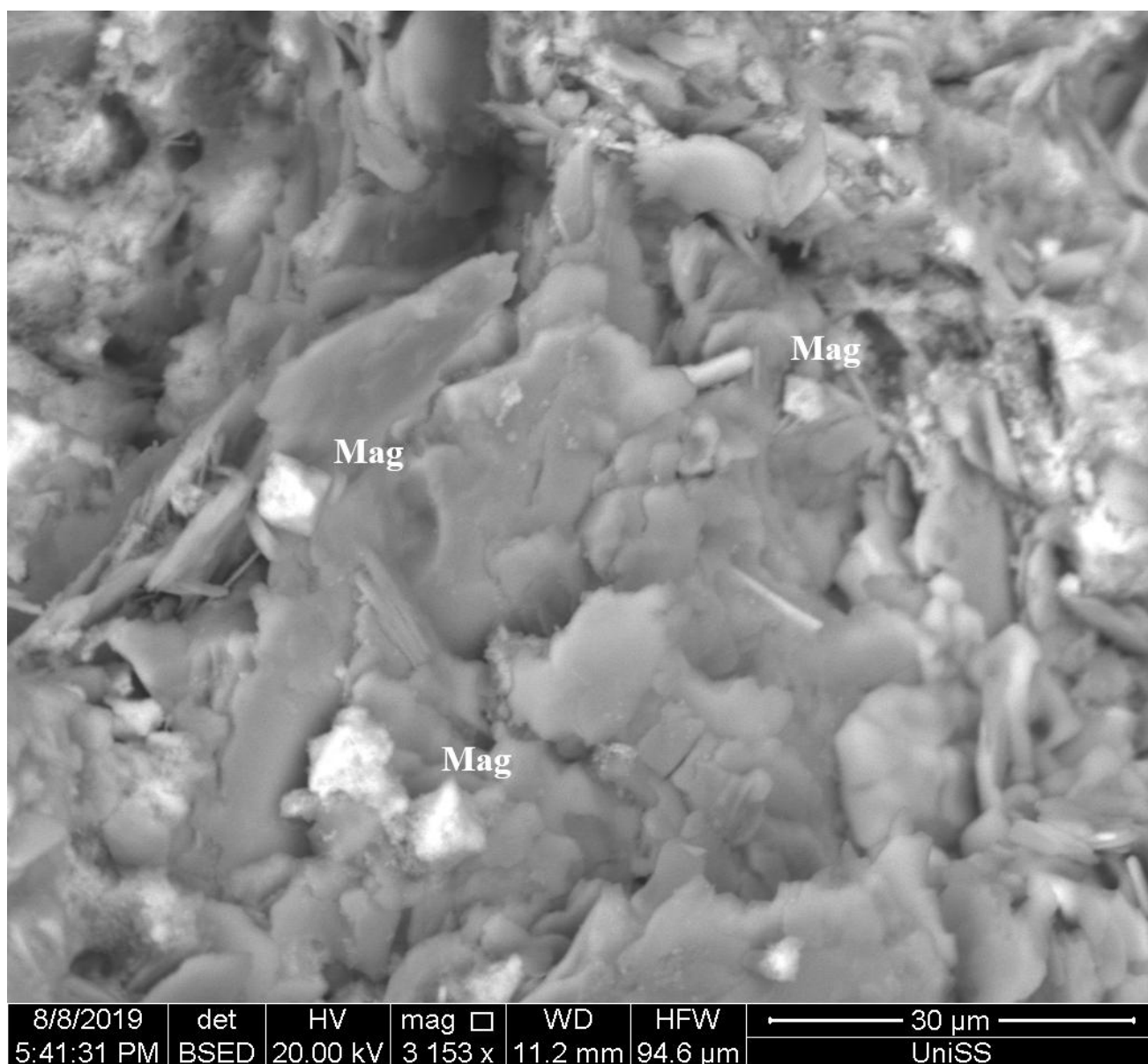
Supplementary Material

1 Supplementary Figures and Tables

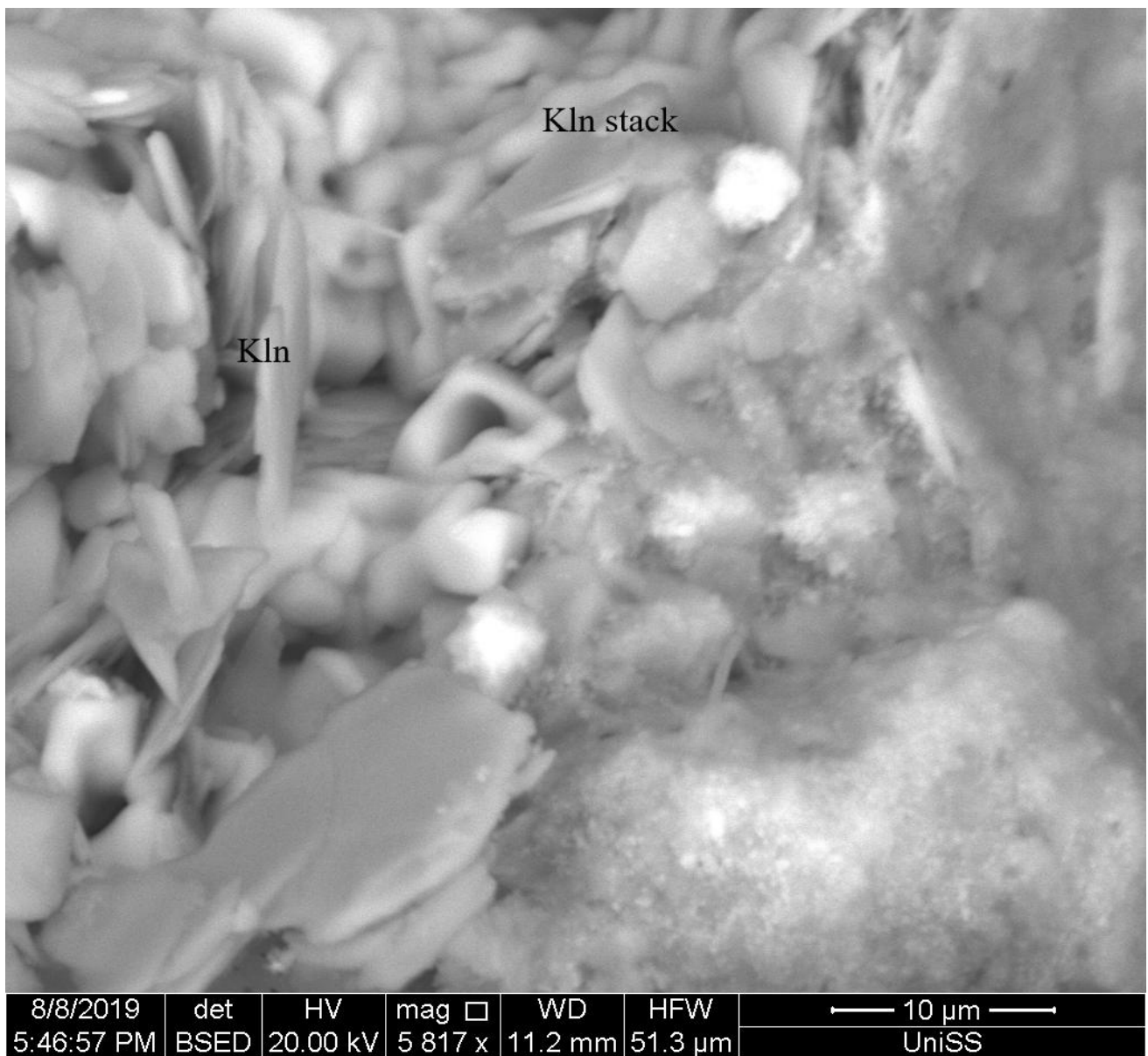
1.1 Supplementary Figures



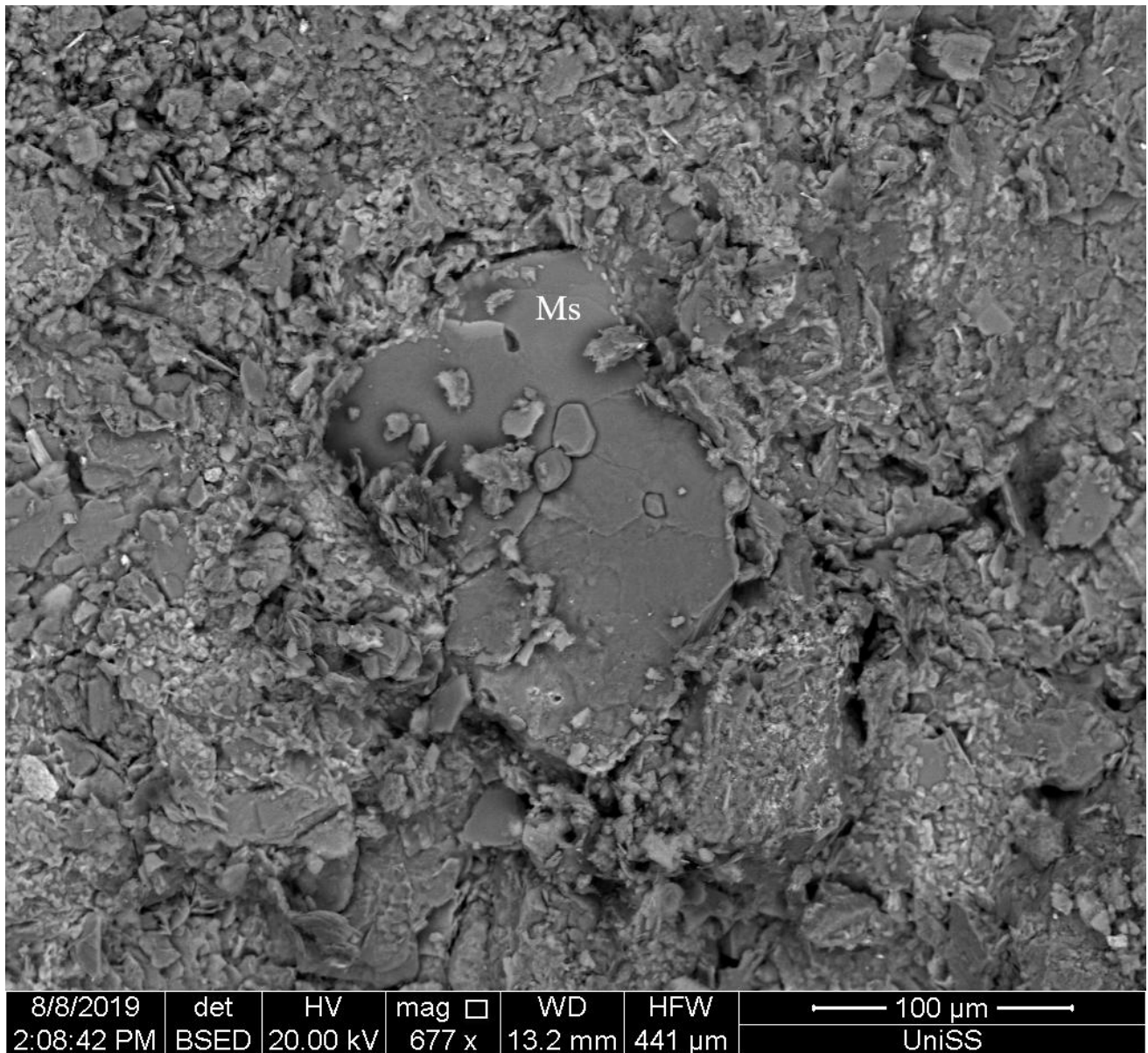
Supplementary Figure 1. Upper and lower MP palaeosols separated by a gravelly level.



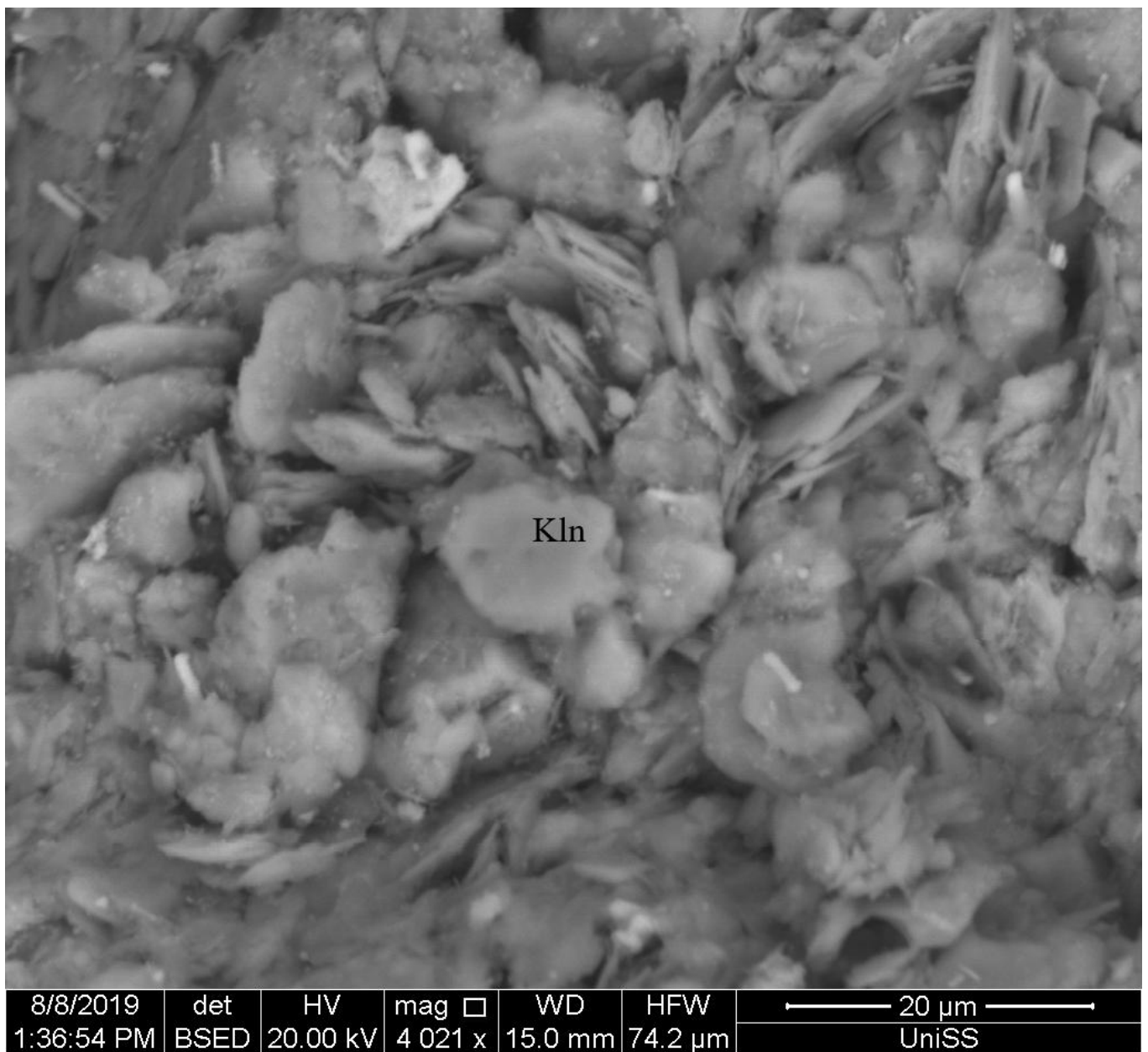
Supplementary Figure 2. SEM image of tiny bipyramidal crystals magnetite in MP1 sample.



Supplementary Figure 3. SEM image of Kaolinite crystals.



Supplementary Figure 4. SEM image of detrital muscovite laminae within the upper Messinian palaeosol. Notice the growing exagonal crystal of kaolinite on the muscovite clast.



Supplementary Figure 5. SEM image of detrital kaolinite in the Cretaceous clays.

1.2 Supplementary Tables

Supplementary Table 1.

XRPD mineral composition of CP and MP samples with semiquantitative interpretations.

Sample	Kln	Ilt	Mnt	Plg	Qz	Fsp	Cal	Rt	Ant	Hem	Gth	Gbs	Bhm	HI
CP01	xxx	x			x			tr	x				tr	
CP02	xxx	tr			tr		xx						x	
CP03	x	x	tr		x			x						
CP04	x		tr				x				x		x	
CP05	x	x	tr							x	x			
CP06	xx	xx			x			x	x		x			
CP07	x	x						x	x	x	x			
CP08														
CP09	x	x			x			x	x		x	x	x	
CP10	x	x						x	x	x	x	x		
CP11	x	x			x			x	x		x			
CP12	x	x					x	x	x		x			
MP01	xx	xxx			xx			x			tr	tr		
MP02	xx	xxx			xxx			x			tr	tr		
MP03	xx	xxx			xx			x	tr		x	tr		
MP04	xx	xx			xxx			x			x	tr		
MP05	x	xx			xxx			x			x	tr		tr
MP06	x	xx			xxx			tr			tr	tr		
MP07	x	x			xxx	x		tr	tr		x			
MP08	x	xx			xxx			x			x	tr		tr
MP09	x	x			xxx			x	x					
MP10	x	xx			xxx			x			tr	tr		
MP11	xx	xxx			xxx			tr			x	tr		
MP12	x	xx			xxx			tr			x	tr		
MP13	x	x		tr	xxx	x		tr			x			
MP14	x	x		tr	xxx	x		tr			x			
MP15	x	xx			xxx			x			x			
MP16	?	tr			xxx						x			
MP17	x	xx			xxx			x						
MP18	x	xx			xxx			x			?			tr
MP19	x	xxx			xxx	x					x	x		tr
MP20	?	tr		x	xxx	x		?			x			
MP21		tr			xxx	x				x				
MP22	x	x			xxx									

Legend. Kln: Kaolinite; Ilt: Illite; Mnt: Montmorillonite; Plg: Palygorskite; Qz: Quartz; Fsp: Feldspar; Cal: Calcite; Rt: Rutile; Ant: Anatase; Hem: Hematite; Gth: Goethite; Gbs: Gibbsite; Bhm: Boehmite; HI: Halite; tr: trace; x: low abundance; xx: moderate abundance; xxx: high abundance.

Supplementary Table 2.

Cretaceous Factor Analysis

	Al ₂ O ₃	Fe ₂ O ₃ (T)	Sc	V	Cr	Ni	Ga	La	Ce	Yb	Th
CP01	3164	13.64	33	342	190	89	38	46.2	207	6.4	215
CP02	27	17.24	27	442	140	265	29	227	185	9	23
CP03	29.43	17.18	33	407	230	168	30	392	463	10.4	27.2
CP04	28.07	15.14	45	310	300	103	38	66.1	205	8.3	26.8
CP05	29.02	15.3	36	331	220	167	32	118	251	10.8	25.6
CP06	26.73	11.56	29	250	180	165	42	124	670	10.9	21
CP07	25.59	12.54	28	272	180	246	38	212	156	9.5	16.6
CP08	27.85	9.62	26	195	130	98	36	60.4	90.4	8.4	20.1
CP09	25.18	10.51	29	213	170	150	38	316	208	12.9	19.1
CP10	24.32	12.33	28	298	170	211	40	324	188	13	21.1
CP11	25.49	10.25	27	197	160	122	32	184	108	7.4	17.5
CP12	23.44	7.9	24	209	200	179	35	79.3	108	7	19.6
	Factor	Factor	Factor		Factor						
	1	2	3		number	Eigenvalue	% of Variance	Cumulative %			
Al ₂ O ₃	0.68				1	4.1952	38.14	38.14			
Fe ₂ O ₃ (T)		0.74			2	2.65965	24.18	62.32			
Sc	0.93				3	1.70611	15.51	77.83			
V		0.81			4	0.901614	8.20	86.02			
Cr	0.82				5	0.620407	5.64	91.66			
Ni					6	0.471673	4.29	95.95			
Ga		-0.85			7	0.250348	2.28	98.23			
La			0.80		8	0.127271	1.16	99.38			
Ce					9	0.057302	0.52	99.91			
Yb			0.90		10	0.0102369	0.09	100.00			
Th	0.82				11	0.000188308	0.00	100.00			

Supplementary Table 3.

Messinian Factor Analysis

	Al ₂ O ₃	Fe ₂ O ₃ (T)	TiO ₂	Sc	V	Cr	Co	Ni	Cu	Ga	Rb	Zr	Th	ΣREE
MP1	32.66	162	1074	24	161	120	2	19	10	40	262	114	117	353
MP2	30.45	3.69	1068	24	169	130	7	21	24	39	239	135	13.5	131
MP3	26.92	9.81	1006	23	221	90	33	70	43	34	208	188	16.1	284
MP4	25.42	7.34	12	21	160	120	7	33	36	34	204	192	18.9	196
MP5	22.95	8.31	1065	21	151	80	11	54	34	30	176	221	18	286
MP6	22.24	7.94	1012	20	150	110	25	49	27	28	199	186	17.7	271
MP7	19.7	9.17	0.785	20	216	130	40	69	29	51	186	198	12.9	376
MP8	21.71	7.98	1034	20	148	80	21	79	34	31	185	233	17.5	286
MP9	19.29	8.85	0.701	20	208	120	21	67	30	51	195	191	13	288
MP10	218	7.06	1145	19	144	80	16	50	30	29	183	228	15.9	261
MP11	20.99	8.17	1101	19	170	100	29	50	30	28	190	269	24.3	424
MP12	2113	7.98	1169	19	178	70	19	55	30	29	176	294	213	365
MP13	20.51	7.69	1213	19	142	140	10	43	27	27	193	248	19.8	282
MP14	20.54	7.67	1038	18	132	120	9	40	26	26	171	272	22.5	372
MP15	2125	7.17	1141	19	141	80	35	101	31	29	171	240	18.7	381
MP16	2126	7.64	1064	19	138	80	14	66	31	29	174	240	18.5	308
MP17	17.92	8.68	0.803	17	156	90	20	55	30	24	162	217	13.9	270
MP18	20.14	7.08	1055	18	132	70	32	61	30	28	165	254	19.9	326
MP19	19.47	7.35	1058	18	134	70	32	84	36	28	166	240	18	300
MP20	18.94	7.62	1052	16	134	80	24	54	29	25	160	283	22.9	374
MP21	16.65	7.72	0.853	15	133	100	16	54	14	36	154	164	10.3	221
MP22	16.41	4.96	0.97	14	103	80	7	39	24	23	150	355	20.3	322
	Factor	Factor	Factor	Factor		Factor								
	1	2	3	4		number	Eigenvalue	% of Variance	Cumulative %					
Al ₂ O ₃	0.91					1	5.51063	39.36	39.36					
Fe ₂ O ₃ (T)		0.83				2	3.18648	22.76	62.12					
TiO ₂			0.86			3	2.0523	14.66	76.78					
Sc	0.97					4	1.13066	8.08	84.86					
V						5	0.924128	6.60	91.46					
Cr						6	0.393618	2.81	94.27					
Co		0.79				7	0.255808	1.83	96.10					
Ni		0.81				8	0.201359	1.44	97.54					
Cu		0.85				9	0.161626	1.15	98.69					
Ga			-0.81			10	0.0837769	0.60	99.29					
Rb	0.91					11	0.0427158	0.31	99.59					
Zr						12	0.0264572	0.19	99.78					
Th			0.78			13	0.0230618	0.17	99.95					
ΣREE				0.94		14	0.00738997	0.05	100.00					