Appendix B

Geochemical Data

APPENDIX B.1.1:

Trace element concentrations obtained from ICP-MS analysis of individual apatite phenocrysts from within the Sprout Brook K-bentonite layer CL# 2(a) from Cobleskill, New York. Since individual crystal weights could not be measured, values shown have no units. Average, standard deviation, 2 sigma standard error of the mean, and percent standard deviation values are shown below each analyte used in further analyses.

Sample Name	P	Ca	Ca/P*	Sr	Y	La	Ce	Pr	Nd	Sm	Eu
CL# 2(a).01	3218.73	6247.70	0.92	1.85	37.19	17.14	43.42	7.34	45.93	9.61	0.27
CL# 2(a).02	3137.25	5935.79	0.89	4.24	29.90	13.94	35.49	5.85	35.31	7.84	0.32
CL# 2(a).03	2402.48	3885.72	0.76	1.75	24.38	10.57	28.11	4.47	26.33	6.06	0.26
CL# 2(a).04	8989.28	18129.76	0.95	7.05	82.04	35.69	92.87	15.57	96.36	23.80	1.33
CL# 2(a).05	4895.63	9430.61	0.91	3.52	48.58	22.11	56.01	9.28	56.53	11.95	0.42
CL# 2(a).06	6863.34	12704.78	0.88	4.37	62.50	28.55	72.08	12.16	71.29	15.54	0.58
CL# 2(a).07	3680.88	6423.11	0.83	2.53	38.58	16.62	43.31	7.11	41.66	9.06	0.33
CL# 2(a).08	8867.16	17977.90	0.96	5.71	86.31	39.63	103.84	16.87	97.38	21.86	0.79
CL# 2(a).09	5334.50	11075.34	0.98	3.28	52.26	24.32	61.09	10.06	60.00	13.02	0.49
CL# 2(a).10	9777.99	19941.75	0.96	6.67	148.29	59.42	160.56	26.29	158.25	35.95	0.76
CL# 2(a).11	5674.75	11588.55	0.97	4.23	58.65	25.75	66.01	10.73	63.22	14.22	0.52
CL# 2(a).12	3766.21	7502.90	0.94	2.46	38.34	16.95	43.78	7.31	43.71	9.98	0.44
CL# 2(a).13	1788.53	2990.74	0.79	0.95	16.49	7.66	19.55	3.17	19.80	4.29	0.16
CL# 2(a).14	2465.66	4095.32	0.79	1.80	32.21	8.62	24.30	4.16	23.83	6.44	0.15
CL# 2(a).15	5583.47	10229.15	0.87	3.65	52.89	22.85	60.56	9.86	55.82	12.70	0.49
CL# 2(a).16	1766.28	4104.03	1.10	2.60	18.29	8.57	21.78	3.50	20.85	4.56	0.16
CL# 2(a).17	4731.68	9427.39	0.94	2.82	50.52	23.08	60.55	9.87	55.89	12.76	0.37
CL# 2(a).18	2348.69	5118.95	1.03	1.90	32.82	13.50	36.66	6.10	33.27	8.02	0.19
CL# 2(a).19	2497.75	5473.21	1.04	1.57	22.51	10.39	26.69	4.35	23.63	5.86	0.21
CL# 2(a).20	1839.44	4397.40	1.13	1.15	21.86	9.67	25.05	4.12	23.97	5.33	0.15
CL# 2(a).21	2745.40	6247.54	1.08	1.75	25.67	12.08	31.08	5.14	29.88	6.60	0.24
CL# 2(a).22	2740.94	6243.49	1.08	1.88	27.19	12.23	32.50	5.24	30.15	7.19	0.28
CL# 2(a).23	5296.03	11127.19	0.99	3.52	48.25	22.27	57.66	9.38	53.62	12.13	0.47
CL# 2(a).24	8293.33	16820.44	0.96	5.61	77.26	34.90	89.95	14.90	86.38	19.32	0.70
CL# 2(a).25	6880.69	14288.70	0.98	4.73	65.94	29.45	75.65	12.24	69.67	15.99	0.59
CL# 2(a).26	3010.31	6935.85	1.09	2.19	29.36	13.02	33.68	5.47	31.93	7.52	0.30
CL# 2(a).27	4800.60	9666.13	0.95	3.36	47.63	21.22	55.07	8.93	50.22	11.39	0.42
CL# 2(a).28	2696.82	5507.24	0.97	1.75	28.69	13.29	34.14	5.61	33.64	7.05	0.23
CL# 2(a).29	2380.00	6541.83	1.30	3.82	21.91	9.85	26.32	4.29	24.18	5.98	0.30
CL# 2(a).30	5099.77	10497.21	0.97	3.89	49.29	21.83	58.68	9.60	55.67	12.45	0.44
CL# 2(a).31	4573.73	9237.20	0.95	3.27	49.16	21.24	55.83	9.16	52.04	11.81	0.40
CL# 2(a).32	3367.90	6907.33	0.97	3.79	50.87	13.38	37.53	6.31	37.22	10.71	0.77
CL# 2(a).33	3086.75	6343.82	0.97	2.58	34.79	12.38	34.48	5.73	33.65	9.22	0.69
CL# 2(a).34	3572.00	7104.45	0.94	2.93	31.68	13.80	37.01	6.15	36.63	9.71	0.62
CL# 2(a).35	3868.77	7748.66	0.95	3.44	36.46	15.12	41.27	6.89	40.69	10.89	0.76
CL# 2(a).36	6561.38	13465.28	0.97	5.34	63.91	27.77	74.61	12.42	75.56	19.28	1.27
CL# 2(a).37	6703.56	13625.81	0.96	5.68	62.61	26.81	71.79	11.97	70.83	19.12	1.25
CL# 2(a).38	2459.80	4884.71	0.94	2.11	22.82	9.23	25.58	4.30	25.40	7.31	0.56
CL# 2(a).39	1464.05	2851.29	0.92	0.90	14.00	5.93	16.33	2.66	15.87	4.48	0.30
CL# 2(a).40	2935.45	5940.74	0.96	2.45	25.85	10.87	28.76	4.87	29.58	8.43	0.64
CL# 2(a).41	1989.92	3580.54	0.85	1.61	21.01	8.28	23.06	3.94	22.99	6.57	0.43
CL# 2(a).42	6213.63	12469.13	0.95	4.20	57.95	26.26	68.77	11.18	63.91	14.85	0.55
CL# 2(a).43	5941.49	12429.21	0.99	4.94	57.67	24.76	64.91	10.96	64.85	16.11	0.94
CL# 2(a).44	3854.98	7864.65	0.96	3.40	39.68	16.73	45.70	7.60	44.63	12.00	0.77
CL# 2(a).45	5360.87	11903.37	1.05	4.89	48.88	21.51	56.49	9.32	56.07	14.32	0.88
CL# 2(a).46	5207.06	10375.00	0.94	4.16	50.99	20.92	57.02	9.33	53.69	13.94	0.90
CL# 2(a).47	3564.14	7120.53	0.94	2.87	35.32	15.14	40.22	6.65	38.87	10.17	0.63
CL# 2(a).48	4981.12	9870.94	0.94	3.61	49.64	21.50	57.60	9.52	54.99	13.44	0.67
CL# 2(a).49	7961.67	16085.64	0.96	6.88	75.71	31.01	84.88	13.92	81.26	21.57	1.48
CL# 2(a).50	4490.26	8959.28	0.94	3.63	43.78	18.00	48.40	8.02	47.27	12.54	0.82
CL# 2(a).51	7272.33	15161.29	0.99	6.20	68.20	28.51	76.87	12.74	76.15	20.10	1.37
		Average		3.44	45.43	19.50	51.44	8.48	49.81	11.98	0.57
		St. Deviation		1.57	23.15	9.87	26.12	4.29	25.60	5.97	0.34
		2 Σ of Mean		0.44	6.42	2.74	7.25	1.19	7.10	1.66	0.09
		% St. Deviation		45.62	50.96	50.65	50.78	50.58	51.40	49.86	58.92

APPENDIX B.1.1 continued:

Sample Name	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Pb	Th	U
CL# 2(a).01	10.04	1.29	7.46	1.64	3.56	0.46	2.23	0.30	-0.85	-0.01	0.12
CL# 2(a).02	7.91	1.04	6.03	1.34	2.95	0.39	1.94	0.24	0.76	-0.22	0.12
CL# 2(a).03	6.42	0.80	4.61	1.03	2.06	0.30	1.45	0.19	-0.34	-0.29	0.09
CL# 2(a).04	24.13	3.10	17.08	3.63	8.00	1.03	15.65	0.65	-0.47	0.76	0.48
CL# 2(a).05	12.72	1.62	9.26	2.09	4.49	0.60	2.99	0.39	1.59	-0.19	0.18
CL# 2(a).06	16.17	2.14	11.99	2.74	5.88	0.77	3.96	0.53	-0.73	-0.06	0.27
CL# 2(a).07	9.52	1.21	6.98	1.58	3.33	0.46	2.29	0.29	-0.68	-0.25	0.14
CL# 2(a).08	23.59	3.10	17.38	3.90	8.40	1.11	5.66	0.71	-0.23	0.61	0.37
CL# 2(a).09	14.20	1.84	10.68	2.40	5.19	0.68	3.47	0.45	-0.39	0.34	0.22
CL# 2(a).10	38.98	5.13	29.01	6.49	14.05	1.81	8.87	1.14	0.18	0.72	0.52
CL# 2(a).11	15.11	1.96	11.35	2.53	5.46	0.73	3.62	0.47	74.88	0.33	0.25
CL# 2(a).12	10.60	1.34	7.69	1.71	3.62	0.48	2.38	0.31	9.56	0.23	0.16
CL# 2(a).13	4.64	0.60	3.50	0.76	1.67	0.22	1.06	0.14	2.72	0.15	0.07
CL# 2(a).14	7.24	1.00	5.91	1.43	3.06	0.41	1.98	0.23	-10.22	0.11	0.11
CL# 2(a).15	14.05	1.77	10.23	2.26	5.07	0.64	3.24	0.41	-9.45	0.34	0.22
CL# 2(a).16	4.87	0.65	3.82	0.84	1.85	0.23	1.22	0.16	-4.45	0.12	0.08
CL# 2(a).17	13.91	1.85	10.48	2.33	4.87	0.63	3.28	0.42	-5.69	0.34	0.20
CL# 2(a).18	8.49	1.16	6.47	1.45	3.11	0.41	2.03	0.25	2.91	0.19	0.12
CL# 2(a).19	6.04	0.79	4.59	1.05	2.28	0.30	1.52	0.20	-5.13	0.18	0.11
CL# 2(a).20	5.83	0.75	4.12	0.92	2.05	0.27	1.31	0.16	-3.17	-0.05	0.08
CL# 2(a).21	7.22	0.89	4.92	1.17	2.42	0.32	1.68	0.19	-3.04	-0.07	0.11
CL# 2(a).22	7.38	0.97	5.46	1.19	2.60	0.34	1.71	0.20	-2.57	-0.04	0.11
CL# 2(a).23	13.13	1.67	9.59	2.11	4.54	0.59	3.04	0.38	-2.65	0.09	0.21
CL# 2(a).24	20.29	2.66	14.87	3.39	7.27	0.98	4.84	0.62	-2.67	0.28	0.33
CL# 2(a).25	16.71	2.19	12.44	2.82	6.07	0.81	4.00	0.51	-2.68	0.19	0.28
CL# 2(a).26	7.85	1.03	5.67	1.30	2.80	0.36	1.85	0.22	-0.83	-0.03	0.12
CL# 2(a).27	12.64	1.58	9.01	2.08	4.48	0.59	2.89	0.37	-1.83	0.45	0.21
CL# 2(a).28	7.89	1.00	5.79	1.28	2.77	0.37	1.80	0.23	-2.34	0.22	0.12
CL# 2(a).29	6.44	0.82	4.41	0.97	2.06	0.27	1.40	0.17	16.05	0.21	0.11
CL# 2(a).30	13.35	1.69	9.32	2.13	4.65	0.61	3.02	0.41	2.23	0.33	0.22
CL# 2(a).31	13.33	1.67	9.26	2.10	4.41	0.60	2.94	0.38	0.29	0.28	0.20
CL# 2(a).32	10.92	1.60	9.61	2.25	5.05	0.71	3.76	0.47	-5.38	1.26	0.55
CL# 2(a).33	9.13	1.21	6.48	1.39	2.87	0.38	1.92	0.24	-4.95	1.51	0.35
CL# 2(a).34	9.55	1.26	6.76	1.44	3.05	0.40	2.08	0.26	-3.35	0.69	0.23
CL# 2(a).35	11.12	1.42	7.77	1.63	3.34	0.45	2.19	0.29	5.01	1.38	0.34
CL# 2(a).36	19.18	2.49	13.27	2.90	6.21	0.80	4.12	0.54	-6.99	1.88	0.57
CL# 2(a).37	18.79	2.45	13.36	2.87	6.08	0.81	4.02	0.53	-4.97	2.30	0.62
CL# 2(a).38	7.06	0.93	4.85	1.04	2.23	0.28	1.43	0.20	-6.78	1.10	0.22
CL# 2(a).39	4.57	0.58	3.08	0.64	1.36	0.18	0.91	0.12	-7.86	0.38	0.09
CL# 2(a).40	8.57	1.10	5.77	1.25	2.42	0.33	1.74	0.22	-6.07	0.58	0.17
CL# 2(a).41	6.72	0.87	4.59	0.95	1.99	0.25	1.25	0.16	-4.69	0.52	0.13
CL# 2(a).42	15.33	2.03	11.49	2.60	5.75	0.75	3.75	0.49	358.99	0.39	0.26
CL# 2(a).43	16.63	2.18	11.90	2.65	5.51	0.75	3.80	0.48	-1.19	0.96	0.52
CL# 2(a).44	11.96	1.56	8.30	1.83	3.76	0.50	2.51	0.33	-2.45	1.79	0.37
CL# 2(a).45	14.68	1.89	10.24	2.22	4.64	0.61	3.06	0.40	7.91	0.84	0.31
CL# 2(a).46	14.34	1.90	10.13	2.20	4.86	0.61	3.28	0.40	-5.45	1.00	0.39
CL# 2(a).47	10.37	1.39	7.58	1.60	3.37	0.43	2.19	0.29	1.20	0.68	0.26
CL# 2(a).48	13.97	1.81	9.78	2.21	4.78	0.62	3.14	0.40	30.55	0.72	0.31
CL# 2(a).49	21.98	2.85	15.82	3.34	6.92	0.92	4.64	0.60	-3.85	1.86	0.68
CL# 2(a).50	12.69	1.70	9.09	1.96	4.18	0.54	2.75	0.36	-6.26	0.93	0.30
CL# 2(a).51	20.44	2.70	14.34	3.14	6.45	0.85	4.25	0.57	-6.17	2.68	0.66
Average	12.52	1.63	9.09	2.02	4.31	0.57	3.06	0.37	7.41	0.56	0.26
St. Deviation	6.28	0.82	4.59	1.02	2.21	0.29	2.27	0.19	51.74	0.67	0.16
2 Σ of Mean	1.74	0.23	1.27	0.28	0.61	0.08	0.63	0.05	14.35	0.19	0.05
% St. Deviation	50.13	50.44	50.55	50.62	51.21	50.53	74.29	50.62	697.99	118.50	63.30

APPENDIX B.1.2:

Percent relative standard deviation values for each element analyzed during ICP-MS analysis of individual apatite phenocrysts from within Sprout Brook K-bentonite layer CL# 2(a) from Cobleskill, New York. These percent values are generated during 5 replicate analyses of each individual crystal analyzed.

Sample Name	P	Ca	Sr	Y	La	Ce	Pr	Nd	Sm
CL# 2(a).01	4.10	5.60	1.38	2.85	2.61	2.92	1.45	2.94	2.13
CL# 2(a).02	8.49	4.60	1.80	2.71	3.13	2.55	2.91	6.68	1.54
CL# 2(a).03	3.49	2.79	4.20	2.65	0.83	2.28	1.73	5.10	4.99
CL# 2(a).04	2.14	1.35	2.84	1.81	3.03	2.07	1.37	4.89	2.51
CL# 2(a).05	3.73	4.18	2.53	3.67	2.60	1.39	3.58	6.10	3.32
CL# 2(a).06	3.98	4.52	3.85	3.14	2.30	2.65	1.87	3.30	3.70
CL# 2(a).07	2.48	4.44	4.28	2.21	1.49	3.16	1.51	4.15	1.87
CL# 2(a).08	11.10	11.18	11.14	9.46	11.50	10.93	10.96	11.30	11.38
CL# 2(a).09	4.61	5.89	4.92	5.97	6.11	7.27	7.62	10.56	8.07
CL# 2(a).10	3.07	4.86	5.04	5.26	3.54	4.23	4.35	4.10	4.18
CL# 2(a).11	3.07	3.30	3.49	2.76	1.77	2.18	2.05	2.64	3.87
CL# 2(a).12	2.74	2.11	1.80	3.40	2.37	2.88	2.26	2.56	3.68
CL# 2(a).13	7.92	11.91	4.44	2.54	1.81	3.06	3.59	2.29	3.89
CL# 2(a).14	3.05	8.62	2.91	3.80	3.94	4.43	3.22	2.69	5.45
CL# 2(a).15	3.99	3.02	4.57	5.30	4.79	4.77	3.43	5.85	2.20
CL# 2(a).16	2.81	3.53	2.00	2.17	1.21	3.93	1.44	4.43	3.18
CL# 2(a).17	2.93	3.47	1.89	4.99	2.49	1.73	2.13	5.89	2.03
CL# 2(a).18	2.25	3.64	3.81	2.29	3.85	3.41	1.57	4.23	1.55
CL# 2(a).19	3.17	7.18	3.32	1.57	1.67	3.87	3.63	3.88	3.50
CL# 2(a).20	2.29	4.33	0.83	1.79	1.48	2.30	3.04	4.04	5.94
CL# 2(a).21	5.05	1.56	2.47	1.84	2.05	1.98	3.08	4.40	2.00
CL# 2(a).22	3.79	2.61	2.42	1.86	2.18	2.33	1.29	5.22	3.12
CL# 2(a).23	3.19	5.07	5.76	5.99	6.27	7.07	5.70	6.32	8.18
CL# 2(a).24	2.65	3.05	1.70	3.07	1.70	1.90	1.23	4.29	2.29
CL# 2(a).25	5.04	5.30	4.92	7.64	4.43	4.75	4.17	4.37	5.95
CL# 2(a).26	3.02	2.53	3.74	2.96	2.69	1.79	2.15	5.56	3.37
CL# 2(a).27	3.68	3.53	1.89	1.01	0.54	1.47	1.71	4.35	3.35
CL# 2(a).28	4.15	5.19	1.45	2.78	2.82	1.77	2.10	3.25	5.85
CL# 2(a).29	1.84	2.01	2.38	1.40	2.36	1.69	2.60	5.33	3.14
CL# 2(a).30	2.20	2.21	1.78	4.30	2.64	2.77	2.75	5.56	4.67
CL# 2(a).31	3.21	2.81	1.91	2.09	1.19	1.78	2.81	7.33	1.93
CL# 2(a).32	4.04	3.01	1.65	2.68	86.71	1.16	1.91	1.28	1.91
CL# 2(a).33	0.78	2.06	3.33	29.48	50.42	1.85	4.78	3.18	3.80
CL# 2(a).34	0.86	1.64	2.33	2.80	118.29	1.18	1.05	2.67	3.27
CL# 2(a).35	2.15	1.76	1.69	2.08	8182.49	1.85	1.95	1.39	2.52
CL# 2(a).36	3.75	2.52	1.08	1.25	77.21	1.78	1.61	1.43	2.59
CL# 2(a).37	2.91	2.16	2.01	1.47	85.29	1.36	1.85	1.06	3.01
CL# 2(a).38	3.90	3.47	2.20	4.66	479.17	1.71	2.74	1.88	2.15
CL# 2(a).39	5.38	3.02	4.18	3.03	239.13	1.96	1.94	2.48	3.47
CL# 2(a).40	2.62	2.69	1.56	4.93	39.07	3.08	1.49	1.11	4.52
CL# 2(a).41	20.53	25.58	21.67	35.00	108.54	35.91	33.14	32.08	32.55
CL# 2(a).42	18.87	21.24	22.76	28.47	227.42	27.54	27.68	27.15	24.46
CL# 2(a).43	3.68	2.68	2.89	7.56	71.80	5.12	5.53	5.40	4.55
CL# 2(a).44	2.95	2.43	3.06	3.69	36.46	3.67	1.71	2.86	4.27
CL# 2(a).45	0.63	2.28	2.09	2.27	25.48	3.45	2.31	2.75	4.56
CL# 2(a).46	0.68	1.31	0.89	2.14	105.29	0.94	2.23	0.59	1.82
CL# 2(a).48	3.89	3.03	1.35	2.03	57.08	1.19	2.08	1.24	2.90
CL# 2(a).49	1.17	2.77	0.66	1.39	83.63	1.48	1.29	1.53	4.16
CL# 2(a).50	0.90	1.92	0.87	1.21	98.17	2.46	3.17	2.54	2.34
CL# 2(a).51	1.75	1.65	0.99	2.15	88.00	0.82	1.34	1.47	4.79

APPENDIX B.1.2 continued

Sample Name	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Pb	Th	U
CL# 2(a).01	5.37	3.28	2.12	1.79	0.95	3.87	6.17	2.87	6.15	8.07	686.80	12.68
CL# 2(a).02	6.23	3.31	1.36	2.53	1.82	4.13	4.55	4.18	2.17	13.03	10.66	7.38
CL# 2(a).03	4.32	3.41	2.44	3.48	1.51	4.46	4.59	2.05	3.62	20.37	5.49	11.41
CL# 2(a).04	1.80	2.00	3.02	5.80	3.69	8.79	5.26	152.13	2.08	5.58	8.13	45.64
CL# 2(a).05	4.89	3.97	1.88	2.86	2.93	2.84	3.15	5.60	2.79	5.68	4.57	5.02
CL# 2(a).06	1.99	2.92	1.76	2.70	3.05	6.47	4.19	2.74	4.15	5.45	70.80	4.07
CL# 2(a).07	2.03	4.98	2.10	2.47	1.65	6.51	4.00	5.82	3.41	8.18	11.21	5.20
CL# 2(a).08	12.39	11.72	11.80	11.80	11.88	10.24	11.69	9.49	12.26	24.07	12.95	14.48
CL# 2(a).09	4.83	9.19	7.63	9.34	7.87	6.64	8.79	8.77	9.51	6.77	9.50	13.80
CL# 2(a).10	7.24	6.43	4.65	3.94	4.26	4.89	5.52	4.41	4.61	31.06	7.64	9.40
CL# 2(a).11	3.35	2.60	2.40	0.72	4.57	4.18	3.17	1.06	2.46	2.35	8.55	3.50
CL# 2(a).12	9.43	5.31	1.64	1.44	3.54	4.99	1.88	5.70	3.77	2.17	5.94	12.16
CL# 2(a).13	13.39	4.69	1.77	3.63	4.35	4.86	5.90	3.94	5.75	26.87	19.26	21.01
CL# 2(a).14	4.68	3.89	6.31	3.80	2.75	2.42	4.35	2.95	3.09	1.10	14.21	14.21
CL# 2(a).15	5.74	5.36	2.10	2.60	3.22	2.45	3.18	1.75	6.05	1.14	8.18	6.96
CL# 2(a).16	4.72	2.40	1.50	4.92	3.24	8.06	2.99	7.81	7.80	2.32	11.44	28.28
CL# 2(a).17	7.31	3.30	3.88	2.26	3.78	3.58	3.40	3.88	3.48	4.48	12.06	4.82
CL# 2(a).18	8.39	3.53	3.34	4.55	3.94	1.00	4.32	2.09	2.17	10.78	15.22	6.16
CL# 2(a).19	4.00	6.34	2.82	4.12	3.97	2.25	4.53	4.49	5.23	4.27	14.67	17.42
CL# 2(a).20	9.28	4.56	5.72	5.25	3.95	5.09	2.71	3.83	3.94	3.68	30.22	15.57
CL# 2(a).21	8.17	3.44	1.86	3.43	3.45	2.65	6.88	4.52	4.33	1.63	8.19	14.90
CL# 2(a).22	4.26	4.23	4.91	4.97	2.07	2.07	3.59	4.75	8.24	1.63	77.06	15.84
CL# 2(a).23	2.74	6.08	6.76	6.88	6.81	4.31	6.00	6.53	3.97	7.12	32.45	7.39
CL# 2(a).24	1.75	2.71	2.91	3.07	1.57	1.57	2.52	1.95	1.92	3.53	5.65	6.67
CL# 2(a).25	5.00	6.07	6.94	6.92	5.57	4.68	4.73	5.72	6.39	1.91	5.91	7.34
CL# 2(a).26	4.81	3.10	1.89	5.92	4.69	4.23	5.05	2.51	5.09	7.68	99.59	3.77
CL# 2(a).27	4.68	2.33	2.30	4.26	3.15	3.20	2.92	4.07	2.63	11.55	3.48	4.95
CL# 2(a).28	11.29	4.01	2.20	1.98	3.11	1.75	3.79	4.18	5.14	2.94	7.40	3.07
CL# 2(a).29	3.69	3.31	2.06	2.18	4.45	3.90	6.18	4.75	3.10	2.01	8.93	2.98
CL# 2(a).30	3.89	5.72	3.20	3.04	3.04	4.89	4.45	2.81	2.69	6.63	3.30	4.12
CL# 2(a).31	8.62	1.52	3.51	3.18	2.47	4.40	5.88	4.47	6.23	72.13	12.63	5.61
CL# 2(a).32	2.94	3.35	3.51	2.10	4.47	3.56	1.35	2.10	1.19	3.03	1.81	2.30
CL# 2(a).33	3.10	2.42	2.06	1.24	3.40	1.82	3.48	2.01	2.13	4.37	2.07	4.99
CL# 2(a).34	2.02	3.06	2.68	1.62	3.84	2.77	5.31	3.58	1.70	2.15	6.03	6.62
CL# 2(a).35	3.28	2.05	0.98	3.36	4.22	2.84	4.86	0.97	2.98	1.86	8.09	6.08
CL# 2(a).36	1.77	4.91	1.13	1.76	2.32	3.70	2.76	1.24	4.02	3.44	1.94	2.85
CL# 2(a).37	1.31	1.72	1.84	1.93	1.82	2.83	1.72	1.26	2.21	1.53	2.38	4.44
CL# 2(a).38	2.09	2.83	2.97	2.05	3.71	2.10	3.02	1.62	2.94	12.00	1.13	3.01
CL# 2(a).39	2.81	2.06	2.61	2.09	1.66	4.09	4.49	4.62	6.99	3.44	0.53	2.11
CL# 2(a).40	2.05	2.15	2.94	2.06	1.26	10.56	5.00	3.64	6.96	4.23	2.64	3.63
CL# 2(a).41	27.67	9.76	28.35	28.28	31.76	31.95	35.33	33.37	35.61	36.36	1.99	8.11
CL# 2(a).42	26.46	29.17	27.58	27.65	28.79	28.42	28.50	29.41	30.37	28.95	1.03	31.42
CL# 2(a).43	4.39	3.08	7.00	4.77	6.23	5.59	7.22	5.64	7.25	5.12	23.97	8.88
CL# 2(a).44	3.32	2.58	2.47	3.70	0.99	3.86	2.96	3.22	2.87	4.05	6.83	4.84
CL# 2(a).45	2.05	2.85	2.11	3.03	2.70	2.23	1.89	4.66	2.50	2.05	2.18	3.86
CL# 2(a).46	1.92	2.63	0.56	4.15	2.06	2.42	2.98	4.22	7.49	4.69	0.74	5.26
CL# 2(a).48	1.88	3.32	3.08	4.04	3.59	2.04	4.04	4.87	4.85	3.30	1.48	1.74
CL# 2(a).49	1.68	0.91	1.39	2.02	5.65	2.64	1.37	3.43	3.86	2.51	2.56	4.09
CL# 2(a).50	3.90	2.44	1.87	2.99	4.40	4.22	2.39	5.89	4.89	2.50	1.51	3.25
CL# 2(a).51	3.02	0.69	1.42	1.17	1.24	2.08	2.70	1.49	3.59	5.32	1.68	4.09

APPENDIX B.1.3:

Rare earth element ratios derived from trace element concentration values found in Appendix B.1.1. for individual apatite phenocrysts from the Sprout Brook K-bentonite layer CL# 2(a) from Locality A near Cobleskill, New York. Mean, standard deviation, 2 Sigma standard error of the mean, and percent standard deviation values for trace elements are below each ratio.

Sample Name	Ce/La	Ce/Pr	Nd/Pr	Nd/Sm	Gd/Sm	Gd/Tb
CL# 2(a).01	2.53	5.92	6.26	4.78	1.04	7.78
CL# 2(a).02	2.55	6.07	6.04	4.50	1.01	7.59
CL# 2(a).03	2.66	6.29	5.90	4.34	1.06	8.02
CL# 2(a).04	2.60	5.96	6.19	4.05	1.01	7.79
CL# 2(a).05	2.53	6.04	6.09	4.73	1.06	7.85
CL# 2(a).06	2.52	5.93	5.86	4.59	1.04	7.57
CL# 2(a).07	2.61	6.09	5.86	4.60	1.05	7.86
CL# 2(a).08	2.62	6.15	5.77	4.46	1.08	7.62
CL# 2(a).09	2.51	6.07	5.96	4.61	1.09	7.71
CL# 2(a).10	2.70	6.11	6.02	4.40	1.08	7.60
CL# 2(a).11	2.56	6.15	5.89	4.45	1.06	7.72
CL# 2(a).12	2.58	5.99	5.98	4.38	1.06	7.91
CL# 2(a).13	2.55	6.18	6.25	4.61	1.08	7.74
CL# 2(a).14	2.82	5.85	5.73	3.70	1.12	7.24
CL# 2(a).15	2.65	6.15	5.66	4.39	1.11	7.92
CL# 2(a).16	2.54	6.22	5.96	4.57	1.07	7.44
CL# 2(a).17	2.62	6.14	5.66	4.38	1.09	7.50
CL# 2(a).18	2.72	6.01	5.46	4.15	1.06	7.32
CL# 2(a).19	2.57	6.14	5.43	4.03	1.03	7.65
CL# 2(a).20	2.59	6.09	5.82	4.50	1.09	7.78
CL# 2(a).21	2.57	6.05	5.81	4.52	1.09	8.09
CL# 2(a).22	2.66	6.20	5.75	4.19	1.03	7.64
CL# 2(a).23	2.59	6.14	5.71	4.42	1.08	7.87
CL# 2(a).24	2.58	6.04	5.80	4.47	1.05	7.64
CL# 2(a).25	2.57	6.18	5.69	4.36	1.05	7.62
CL# 2(a).26	2.59	6.16	5.84	4.25	1.04	7.61
CL# 2(a).27	2.60	6.17	5.62	4.41	1.11	8.01
CL# 2(a).28	2.57	6.09	6.00	4.77	1.12	7.90
CL# 2(a).29	2.67	6.14	5.64	4.04	1.08	7.90
CL# 2(a).30	2.69	6.11	5.80	4.47	1.07	7.89
CL# 2(a).31	2.63	6.09	5.68	4.41	1.13	7.98
CL# 2(a).32	2.80	5.95	5.90	3.47	1.02	6.81
CL# 2(a).33	2.79	6.02	5.87	3.65	0.99	7.56
CL# 2(a).34	2.68	6.02	5.95	3.77	0.98	7.57
CL# 2(a).35	2.73	5.99	5.91	3.74	1.02	7.81
CL# 2(a).36	2.69	6.01	6.08	3.92	0.99	7.69
CL# 2(a).37	2.68	6.00	5.92	3.70	0.98	7.67
CL# 2(a).38	2.77	5.95	5.90	3.47	0.97	7.60
CL# 2(a).39	2.75	6.14	5.97	3.55	1.02	7.88
CL# 2(a).40	2.65	5.91	6.08	3.51	1.02	7.81
CL# 2(a).41	2.78	5.85	5.84	3.50	1.02	7.74
CL# 2(a).42	2.62	6.15	5.72	4.30	1.03	7.57
CL# 2(a).43	2.62	5.92	5.92	4.02	1.03	7.64
CL# 2(a).44	2.73	6.02	5.87	3.72	1.00	7.66
CL# 2(a).45	2.63	6.06	6.01	3.92	1.03	7.78
CL# 2(a).46	2.72	6.11	5.75	3.85	1.03	7.55
CL# 2(a).48	2.68	6.05	5.78	4.09	1.04	7.71
CL# 2(a).49	2.74	6.10	5.84	3.77	1.02	7.71
CL# 2(a).50	2.69	6.04	5.90	3.77	1.01	7.48
CL# 2(a).51	2.70	6.04	5.98	3.79	1.02	7.57
Average	2.64	6.06	5.87	4.15	1.05	7.69
St. Deviation	0.08	0.10	0.17	0.39	0.04	0.22
2 Σ of Mean	0.02	0.03	0.05	0.11	0.01	0.06
% St. Deviation	3.01	1.57	2.90	9.31	3.72	2.81

APPENDIX B.1.3 continued:

Sample Name	Dy/Tb	Dy/Ho	Er/Ho	Er/Tm	Yb/Tm	Yb/Lu
CL# 2(a).01	5.78	4.56	2.18	7.67	4.79	7.45
CL# 2(a).02	5.78	4.49	2.20	7.52	4.95	8.08
CL# 2(a).03	5.76	4.49	2.01	6.85	4.81	7.62
CL# 2(a).04	5.51	4.71	2.21	7.80	15.25	23.89
CL# 2(a).05	5.71	4.43	2.15	7.47	4.98	7.71
CL# 2(a).06	5.61	4.38	2.15	7.64	5.14	7.46
CL# 2(a).07	5.76	4.41	2.11	7.26	4.98	7.95
CL# 2(a).08	5.61	4.45	2.15	7.57	5.10	7.96
CL# 2(a).09	5.80	4.45	2.17	7.62	5.09	7.64
CL# 2(a).10	5.66	4.47	2.17	7.78	4.91	7.80
CL# 2(a).11	5.80	4.48	2.16	7.52	4.99	7.64
CL# 2(a).12	5.75	4.49	2.11	7.58	4.99	7.62
CL# 2(a).13	5.84	4.59	2.18	7.60	4.84	7.71
CL# 2(a).14	5.91	4.13	2.14	7.42	4.80	8.46
CL# 2(a).15	5.77	4.53	2.24	7.88	5.03	7.84
CL# 2(a).16	5.84	4.53	2.20	7.89	5.17	7.80
CL# 2(a).17	5.65	4.51	2.09	7.71	5.19	7.85
CL# 2(a).18	5.58	4.46	2.15	7.66	4.99	8.08
CL# 2(a).19	5.81	4.39	2.18	7.68	5.11	7.50
CL# 2(a).20	5.49	4.49	2.24	7.50	4.80	8.37
CL# 2(a).21	5.52	4.20	2.06	7.44	5.19	8.66
CL# 2(a).22	5.65	4.57	2.18	7.65	5.02	8.44
CL# 2(a).23	5.75	4.54	2.15	7.66	5.13	8.08
CL# 2(a).24	5.60	4.39	2.14	7.44	4.96	7.77
CL# 2(a).25	5.68	4.41	2.15	7.46	4.92	7.78
CL# 2(a).26	5.49	4.36	2.15	7.75	5.13	8.46
CL# 2(a).27	5.71	4.32	2.15	7.57	4.88	7.76
CL# 2(a).28	5.81	4.54	2.17	7.40	4.83	7.82
CL# 2(a).29	5.41	4.56	2.13	7.60	5.15	8.15
CL# 2(a).30	5.51	4.37	2.18	7.57	4.92	7.43
CL# 2(a).31	5.54	4.40	2.10	7.37	4.92	7.73
CL# 2(a).32	6.00	4.27	2.24	7.14	5.32	7.98
CL# 2(a).33	5.37	4.67	2.07	7.60	5.09	7.87
CL# 2(a).34	5.36	4.71	2.12	7.53	5.14	7.93
CL# 2(a).35	5.45	4.77	2.05	7.47	4.90	7.59
CL# 2(a).36	5.32	4.57	2.14	7.77	5.15	7.68
CL# 2(a).37	5.45	4.66	2.12	7.50	4.95	7.62
CL# 2(a).38	5.22	4.66	2.14	8.02	5.13	7.26
CL# 2(a).39	5.31	4.78	2.11	7.77	5.20	7.90
CL# 2(a).40	5.25	4.60	1.93	7.40	5.31	7.97
CL# 2(a).41	5.28	4.84	2.10	7.84	4.91	7.78
CL# 2(a).42	5.67	4.42	2.21	7.70	5.02	7.59
CL# 2(a).43	5.47	4.49	2.08	7.37	5.09	7.97
CL# 2(a).44	5.32	4.52	2.05	7.49	4.99	7.60
CL# 2(a).45	5.43	4.62	2.09	7.65	5.05	7.70
CL# 2(a).46	5.33	4.60	2.21	7.95	5.35	8.10
CL# 2(a).48	5.40	4.42	2.16	7.67	5.03	7.92
CL# 2(a).49	5.55	4.74	2.07	7.50	5.03	7.75
CL# 2(a).50	5.35	4.63	2.13	7.75	5.10	7.68
CL# 2(a).51	5.31	4.57	2.06	7.56	4.98	7.46
Average	5.58	4.52	2.14	7.59	5.23	8.14
St. Deviation	0.20	0.15	0.06	0.20	1.44	2.27
2 Σ of Mean	0.05	0.04	0.02	0.06	0.40	0.63
% St. Deviation	3.51	3.22	2.78	2.68	27.48	27.84

APPENDIX B.1.4:

Trace element concentrations obtained from ICP-MS analysis of individual apatite phenocrysts from within the Sprout Brook K-bentonite layer CL# 2(b) from Cobleskill, New York. Since individual crystal weights could not be measured, values shown have no units. Average, standard deviation, 2 sigma standard error of the mean, and percent standard deviation values are shown below each analyte used in further analyses.

Sample Name	P	Ca	Ca/P*	Sr	Y	La	Ce	Pr	Nd	Sm	Eu
CL# 2(b).01	5413.10	10611.34	0.93	3.72	24.26	20.34	59.19	10.38	60.98	16.81	0.43
CL# 2(b).02	5624.20	10380.34	0.87	3.85	26.00	21.31	64.11	11.07	64.71	18.26	0.46
CL# 2(b).03	4305.88	9274.68	1.02	4.56	15.67	13.16	37.12	6.84	42.19	11.41	0.33
CL# 2(b).04	3929.83	8603.23	1.04	2.95	14.98	13.28	40.60	7.07	42.08	12.32	0.36
CL# 2(b).05	4450.52	8840.68	0.94	2.70	19.91	17.13	50.04	8.67	51.43	14.41	0.35
CL# 2(b).06	5260.85	11017.89	0.99	3.33	24.36	21.03	59.73	10.48	64.60	17.23	0.43
CL# 2(b).07	1569.34	3017.51	0.91	0.97	8.91	7.41	22.06	3.75	21.74	6.18	0.15
CL# 2(b).08	1653.49	2868.15	0.82	0.71	7.18	6.58	19.32	3.23	18.40	5.18	0.14
CL# 2(b).09	2593.76	4490.89	0.82	1.43	11.39	9.91	29.97	5.09	27.97	8.25	0.20
CL# 2(b).10	3282.24	5908.66	0.85	2.09	12.95	11.49	35.60	6.20	35.96	10.75	0.27
CL# 2(b).11	4563.15	8376.77	0.87	2.99	20.03	16.46	49.54	8.41	48.62	13.92	0.38
CL# 2(b).12	966.81	2056.21	1.01	0.36	3.43	3.07	9.09	1.59	9.25	2.79	0.08
CL# 2(b).13	1117.41	2487.26	1.05	0.38	3.99	3.97	11.77	2.10	12.29	3.70	0.09
CL# 2(b).14	3394.30	6684.40	0.93	2.33	9.99	10.07	31.00	5.09	28.00	8.89	0.25
CL# 2(b).15	1362.44	3203.12	1.11	0.65	4.85	4.54	14.12	2.45	13.91	4.34	0.11
CL# 2(b).16	1830.02	3981.05	1.03	0.92	8.36	7.50	21.53	3.72	22.22	6.08	0.15
CL# 2(b).17	2214.72	4800.19	1.02	1.24	10.32	9.13	26.06	4.52	26.27	7.56	0.20
CL# 2(b).18	2775.18	6392.41	1.09	2.67	11.66	9.99	30.23	5.29	30.54	9.41	0.25
CL# 2(b).19	2741.14	6224.80	1.07	2.03	9.86	9.35	28.36	4.86	28.14	8.54	0.23
CL# 2(b).20	2789.77	6320.64	1.07	1.93	9.81	9.64	29.35	5.19	29.35	8.94	0.25
CL# 2(b).21	1354.84	2869.41	1.00	1.09	6.61	5.62	15.90	2.87	17.01	4.69	0.13
CL# 2(b).22	1849.00	3773.62	0.96	1.29	8.82	7.66	22.59	3.89	22.18	6.38	0.15
CL# 2(b).23	1136.40	2306.33	0.96	0.86	5.52	4.73	14.15	2.37	13.93	4.00	0.10
CL# 2(b).24	2607.53	5456.50	0.99	1.89	11.64	9.56	27.92	4.81	27.91	8.27	0.22
CL# 2(b).25	4738.48	9543.75	0.95	4.02	28.24	18.47	55.89	9.70	59.13	18.02	0.92
CL# 2(b).26	2301.98	4673.90	0.96	2.50	13.54	8.41	25.12	4.45	28.00	8.89	0.62
CL# 2(b).27	5605.80	11233.97	0.95	4.87	27.82	19.61	58.89	10.37	61.78	19.69	1.14
CL# 2(b).28	2103.09	4277.89	0.96	1.91	10.64	6.70	21.91	3.91	23.27	8.05	0.50
CL# 2(b).29	2081.74	4088.14	0.93	1.69	12.02	7.84	24.62	4.30	25.27	8.31	0.49
CL# 2(b).30	12161.10	23878.03	0.93	10.96	42.71	30.92	112.31	17.42	98.17	35.22	2.13
CL# 2(b).31	7054.10	14190.69	0.95	5.66	31.42	24.63	73.83	12.89	75.49	23.93	1.00
CL# 2(b).32	10003.99	20358.29	0.96	8.68	49.82	37.18	111.66	19.37	140.31	34.81	1.60
CL# 2(b).33	9820.28	19857.20	0.96	9.59	46.80	28.79	92.72	16.40	98.57	32.58	2.13
CL# 2(b).34	2077.71	4278.63	0.97	2.31	11.05	6.65	22.52	3.92	23.14	7.92	0.54
CL# 2(b).35	6587.92	13589.74	0.98	6.44	28.60	19.69	62.64	10.95	62.74	21.79	1.32
CL# 2(b).36	2425.85	4776.09	0.93	2.18	11.21	7.70	23.82	4.26	25.50	8.32	0.46
CL# 2(b).37	1143.49	2015.11	0.83	1.00	6.49	4.09	13.55	2.38	14.29	4.83	0.31
CL# 2(b).38	2354.20	4512.65	0.91	1.92	12.18	8.91	26.96	4.76	28.05	9.19	0.46
CL# 2(b).39	7168.50	14073.67	0.93	6.32	35.80	29.07	71.75	12.67	74.53	24.11	1.34
		Average		3.00	16.89	13.12	39.68	6.86	40.97	12.41	0.53
		St. Deviation		2.52	11.92	8.46	26.22	4.44	28.32	8.50	0.53
		2 Σ of Mean		0.81	3.82	2.71	8.40	1.42	9.07	2.72	0.17
		% St. Deviation		84.03	70.58	64.51	66.08	64.68	69.12	68.54	100.28

APPENDIX B.1.4 continued

Sample Name	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Pb	Th	U
CL# 2(b).01	16.25	1.86	7.43	0.89	1.23	0.10	0.44	0.05	-0.61	-0.20	0.29
CL# 2(b).02	17.88	2.12	8.39	1.03	1.30	0.10	0.47	0.05	-0.85	-0.21	0.35
CL# 2(b).03	10.71	1.22	4.65	0.59	0.84	0.08	0.38	0.04	7.29	-0.38	0.23
CL# 2(b).04	11.70	1.32	4.69	0.61	0.88	0.07	0.32	0.04	0.48	0.32	0.26
CL# 2(b).05	14.12	1.65	6.29	0.79	1.08	0.08	0.35	0.04	-0.07	0.12	0.25
CL# 2(b).06	17.03	2.00	7.63	0.99	1.26	0.10	0.43	0.05	0.05	0.16	0.30
CL# 2(b).07	6.10	0.70	2.74	0.34	0.45	0.03	0.16	0.02	0.48	0.06	0.12
CL# 2(b).08	5.35	0.62	2.45	0.30	0.38	0.03	0.14	0.01	-10.60	0.21	0.10
CL# 2(b).09	8.44	0.97	3.74	0.47	0.57	0.04	0.23	0.03	-10.84	0.17	0.17
CL# 2(b).10	10.35	1.19	4.41	0.53	0.69	0.05	0.21	0.02	-8.68	0.18	0.20
CL# 2(b).11	13.86	1.65	5.96	0.78	1.05	0.08	0.33	0.04	-9.60	0.16	0.25
CL# 2(b).12	2.59	0.29	1.10	0.15	0.22	0.02	0.10	0.01	-7.65	0.17	0.05
CL# 2(b).13	3.55	0.39	1.41	0.17	0.19	0.02	0.07	0.01	-2.28	0.07	0.08
CL# 2(b).14	8.42	0.93	3.41	0.40	0.56	0.04	0.18	0.03	-6.26	0.11	0.17
CL# 2(b).15	4.10	0.46	1.64	0.20	0.29	0.02	0.09	0.01	-7.11	0.07	0.10
CL# 2(b).16	6.02	0.67	2.54	0.32	0.42	0.04	0.14	0.02	-7.59	0.06	0.12
CL# 2(b).17	7.24	0.81	3.10	0.41	0.50	0.04	0.18	0.02	-7.02	0.14	0.14
CL# 2(b).18	8.90	1.00	3.62	0.48	0.71	0.05	0.25	0.01	0.81	0.07	0.20
CL# 2(b).19	7.93	0.89	3.29	0.41	0.53	0.04	0.16	0.00	-1.25	-0.13	0.18
CL# 2(b).20	8.60	0.96	3.30	0.40	0.49	0.04	0.15	0.00	-2.71	-0.14	0.22
CL# 2(b).21	4.92	0.53	1.97	0.25	0.33	0.03	0.11	0.01	-0.90	0.07	0.10
CL# 2(b).22	6.62	0.71	2.78	0.35	0.45	0.04	0.13	0.02	-0.83	0.09	0.12
CL# 2(b).23	4.09	0.43	1.68	0.22	0.27	0.02	0.10	0.01	-1.04	0.06	0.07
CL# 2(b).24	8.08	0.91	3.46	0.44	0.54	0.04	0.19	0.02	-1.57	0.10	0.14
CL# 2(b).25	16.97	2.04	8.15	1.09	1.62	0.15	0.73	0.09	-6.20	2.04	0.56
CL# 2(b).26	8.32	1.00	4.36	0.59	0.88	0.11	0.52	0.06	-3.14	1.51	0.40
CL# 2(b).27	18.74	2.21	8.90	1.24	1.89	0.21	0.99	0.13	-6.30	2.35	0.96
CL# 2(b).28	7.17	0.87	3.94	0.47	0.75	0.10	0.46	0.05	-7.62	1.04	0.35
CL# 2(b).29	7.82	0.95	3.92	0.54	0.81	0.09	0.67	0.05	-7.35	1.04	0.40
CL# 2(b).30	32.27	3.67	13.75	1.87	2.89	0.28	1.42	0.19	-1.70	3.08	1.14
CL# 2(b).31	22.35	2.59	9.92	1.39	1.86	0.15	0.79	0.09	-3.76	0.92	0.57
CL# 2(b).32	32.49	3.85	15.25	2.25	3.26	0.32	1.52	0.22	-4.57	3.04	1.27
CL# 2(b).33	28.42	3.32	13.43	1.93	3.79	0.37	1.97	0.24	-0.93	3.73	1.78
CL# 2(b).34	7.14	0.83	3.29	0.49	0.80	0.09	0.48	0.06	-4.25	1.61	0.39
CL# 2(b).35	19.76	2.31	8.70	1.23	1.97	0.20	1.03	0.14	39.64	-57.04	0.85
CL# 2(b).36	7.78	0.89	3.40	0.54	0.94	0.09	0.48	0.05	-3.45	1.03	0.26
CL# 2(b).37	4.25	0.52	2.09	0.32	0.47	0.06	0.50	0.05	-5.11	0.74	0.23
CL# 2(b).38	8.66	1.02	3.96	0.57	0.71	0.06	0.33	0.03	-4.75	0.54	0.21
CL# 2(b).39	22.38	2.73	10.97	1.57	2.40	0.27	1.21	0.15	-3.75	1.93	0.92
Average	11.73	1.36	5.27	0.71	1.03	0.10	0.47	0.06	-2.60	-0.80	0.37
St. Deviation	7.75	0.91	3.60	0.52	0.85	0.09	0.44	0.06	7.89	9.30	0.38
2 Σ of Mean	2.48	0.29	1.15	0.17	0.27	0.03	0.14	0.02	2.53	2.98	0.12
% St. Deviation	66.05	67.22	68.32	73.16	82.50	90.37	93.73	105.73	-302.91	-1165.34	102.03

APPENDIX B.1.5:

Percent relative standard deviation values for each element analyzed during ICP-MS analysis of individual apatite phenocrysts from within Sprout Brook K-bentonite layer CL# 2(a) from Cobleskill, New York. These percent values are generated during 5 replicate analyses of each individual crystal analyzed

Sample Name	P	Ca	Sr	Y	La	Ce	Pr	Nd	Sm
CL# 2(b).01	5.01	5.84	3.31	2.64	3.60	1.82	2.39	4.03	1.95
CL# 2(b).02	2.28	3.57	2.51	4.83	0.89	3.11	1.93	2.52	0.86
CL# 2(b).03	5.68	3.36	3.10	4.61	1.37	3.57	1.58	4.46	1.32
CL# 2(b).04	3.89	3.59	8.14	5.13	5.77	3.86	5.66	3.79	3.43
CL# 2(b).05	1.43	2.33	3.82	4.11	3.82	4.41	3.98	5.65	4.83
CL# 2(b).06	2.89	3.66	4.77	2.42	2.79	3.24	2.44	4.53	2.68
CL# 2(b).07	6.61	9.63	5.94	3.18	4.69	5.56	4.55	6.60	4.49
CL# 2(b).08	1.08	11.94	2.25	1.67	2.77	5.22	2.49	6.72	2.25
CL# 2(b).09	10.75	10.49	6.19	5.92	3.49	1.90	1.76	7.91	2.65
CL# 2(b).10	1.95	7.24	3.96	2.31	1.93	4.35	3.37	5.06	3.81
CL# 2(b).11	6.46	5.12	1.22	2.87	1.94	1.19	2.49	5.88	1.32
CL# 2(b).12	6.49	9.42	4.83	5.14	3.26	3.15	3.92	9.50	6.78
CL# 2(b).13	17.38	19.56	6.70	4.30	3.20	5.18	2.28	4.34	4.82
CL# 2(b).14	2.00	3.04	5.40	2.77	2.43	1.79	1.94	2.95	3.19
CL# 2(b).15	9.30	9.34	3.35	4.83	3.37	2.19	1.86	8.40	4.25
CL# 2(b).16	5.16	4.46	5.08	3.94	3.20	3.36	1.86	6.07	4.68
CL# 2(b).17	4.76	1.64	3.72	3.95	1.04	2.72	2.54	1.97	4.92
CL# 2(b).18	3.45	2.47	3.95	6.09	6.28	5.90	5.83	6.60	6.47
CL# 2(b).19	4.46	2.24	3.00	5.09	2.16	3.89	4.22	3.91	1.21
CL# 2(b).20	3.04	3.05	2.79	5.45	4.71	3.48	3.12	4.16	3.98
CL# 2(b).21	3.57	6.09	3.59	6.41	2.64	1.24	2.08	4.44	3.62
CL# 2(b).22	4.04	3.04	2.54	2.36	3.05	2.03	1.28	6.15	3.48
CL# 2(b).23	0.84	1.91	3.50	3.10	1.91	3.13	2.00	4.81	3.49
CL# 2(b).24	4.79	1.69	2.96	2.66	1.43	1.93	1.74	3.14	2.62
CL# 2(b).25	1.60	1.14	1.91	16.33	545.62	1.55	1.15	2.43	6.08
CL# 2(b).26	4.47	3.01	2.19	8.46	133.23	1.95	1.31	1.45	5.14
CL# 2(b).27	2.82	1.53	1.29	2.96	19.59	1.66	2.57	0.99	4.25
CL# 2(b).28	3.00	4.67	1.72	1.35	444.77	2.00	1.23	1.21	3.76
CL# 2(b).29	2.44	2.47	1.92	2.88	169.81	1.59	1.69	1.50	1.81
CL# 2(b).30	25.51	26.82	21.65	23.01	130.38	31.56	43.18	30.11	33.09
CL# 2(b).31	23.58	26.75	23.45	29.33	1232.99	31.36	30.92	29.77	27.65
CL# 2(b).32	1.14	0.84	1.91	1.41	105.43	1.18	1.82	2.39	38.26
CL# 2(b).33	2.14	1.43	1.33	18.08	58.74	1.21	0.77	1.31	2.83
CL# 2(b).34	2.59	3.37	1.63	2.34	580.78	2.48	1.69	1.94	3.78
CL# 2(b).35	1.08	1.35	0.62	2.41	73.20	0.58	2.27	1.48	1.82
CL# 2(b).36	3.00	3.02	5.05	7.39	53.03	7.20	5.32	7.33	10.81
CL# 2(b).37	2.58	4.13	2.07	1.32	165.13	5.65	2.15	4.51	4.68
CL# 2(b).38	19.29	22.82	20.14	25.72	224.14	29.91	29.22	29.62	29.40
CL# 2(b).39	26.43	28.69	22.17	26.41	99.80	66.00	31.15	29.76	31.46

APPENDIX B.1.5 continued

Sample Name	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Pb	Th	U
CL# 2(b).01	4.69	3.66	2.18	3.40	2.39	4.23	4.52	7.38	8.59	4.76	6.24	5.45
CL# 2(b).02	4.21	1.78	1.02	2.21	5.47	6.30	6.65	8.02	11.09	7.69	13.69	4.12
CL# 2(b).03	3.16	1.42	2.49	2.87	8.09	5.09	6.95	7.36	14.50	1.40	6.07	4.71
CL# 2(b).04	7.68	4.80	4.45	4.26	4.63	11.24	6.51	10.65	9.13	13.10	10.33	9.46
CL# 2(b).05	3.02	3.31	4.03	2.86	3.04	5.07	5.26	10.69	5.38	80.08	9.16	12.07
CL# 2(b).06	6.46	3.20	1.74	3.52	2.92	6.89	7.49	9.97	9.65	75.45	18.18	9.12
CL# 2(b).07	9.28	6.05	5.20	7.82	5.14	8.09	11.64	9.24	15.79	7.51	27.44	9.67
CL# 2(b).08	9.58	3.97	6.34	6.95	7.56	9.70	18.34	23.59	17.86	1.42	11.60	10.48
CL# 2(b).09	8.07	5.48	6.16	9.51	3.55	0.79	17.83	16.04	22.31	1.02	12.82	7.58
CL# 2(b).10	2.99	2.14	3.38	5.83	8.34	14.52	17.28	11.44	10.98	1.53	8.08	5.12
CL# 2(b).11	3.96	2.26	2.48	3.02	3.25	8.02	8.36	9.33	13.31	2.17	16.57	8.88
CL# 2(b).12	8.58	4.28	4.09	8.87	5.73	23.44	4.27	18.35	20.17	1.93	20.51	14.71
CL# 2(b).13	9.41	6.63	4.58	3.46	7.71	10.54	29.34	20.85	16.92	17.86	43.65	22.09
CL# 2(b).14	3.31	2.29	3.36	5.69	1.90	19.04	5.70	11.99	17.55	3.66	15.96	4.83
CL# 2(b).15	11.61	4.22	3.39	4.36	5.58	17.58	9.46	26.90	30.26	2.63	71.80	11.40
CL# 2(b).16	5.77	2.52	2.87	4.75	5.28	9.73	13.10	9.07	24.23	1.90	36.76	5.32
CL# 2(b).17	5.67	3.05	3.23	4.83	4.52	20.10	11.51	13.11	18.21	1.14	32.56	11.80
CL# 2(b).18	9.10	6.76	5.06	6.30	5.74	8.07	6.57	3.67	28.80	20.99	41.24	6.74
CL# 2(b).19	8.60	2.14	5.28	6.03	5.44	8.64	7.48	15.99	144.94	9.86	12.79	2.67
CL# 2(b).20	4.09	2.97	3.70	3.60	6.49	14.91	11.86	19.34	195.37	1.38	8.84	9.27
CL# 2(b).21	8.93	4.97	4.01	3.66	5.76	20.67	15.58	16.49	25.89	19.56	25.17	6.83
CL# 2(b).22	7.45	3.73	3.20	3.04	5.17	5.40	10.83	13.76	15.80	12.91	28.26	7.04
CL# 2(b).23	8.22	3.00	3.80	1.83	8.41	31.76	11.17	33.44	43.58	10.81	18.96	6.11
CL# 2(b).24	8.72	1.31	3.28	5.50	3.13	12.31	14.00	11.16	22.09	9.00	18.99	9.01
CL# 2(b).25	1.80	2.16	2.39	1.81	2.21	3.53	5.21	14.76	4.82	7.00	0.99	1.96
CL# 2(b).26	1.61	7.88	2.96	2.46	19.05	9.09	6.81	26.77	28.19	8.09	1.82	18.58
CL# 2(b).27	2.23	2.60	4.18	2.28	2.36	1.56	4.04	19.10	9.16	12.12	0.66	3.89
CL# 2(b).28	1.38	5.27	2.71	1.46	24.96	6.16	6.01	26.52	20.46	5.85	0.75	4.52
CL# 2(b).29	2.99	2.98	4.62	2.55	3.52	2.21	4.43	29.48	79.43	11.04	1.54	13.99
CL# 2(b).30	27.12	17.98	26.77	25.68	24.66	21.45	21.04	14.90	17.10	17.64	31.46	13.34
CL# 2(b).31	27.34	16.51	28.09	29.42	28.93	27.02	28.68	32.70	16.95	22.06	6.43	8.14
CL# 2(b).32	3.01	3.23	2.30	1.85	2.72	10.17	6.58	4.36	7.17	30.13	1.85	7.38
CL# 2(b).33	1.47	2.00	1.80	2.92	3.59	5.38	16.48	8.22	7.47	5.63	22.03	6.17
CL# 2(b).34	1.23	5.37	2.16	1.49	4.44	2.82	5.51	6.79	4.20	1.91	4.88	1.89
CL# 2(b).35	2.31	2.30	2.58	1.62	0.68	2.44	6.72	6.29	3.32	1.99	0.83	232.87
CL# 2(b).36	6.85	3.78	7.40	6.54	5.19	18.65	30.09	13.68	36.05	13.57	3.42	4.00
CL# 2(b).37	2.98	3.96	6.44	1.77	5.47	14.39	7.92	28.37	68.29	73.44	1.86	23.73
CL# 2(b).38	24.44	17.32	24.90	28.00	26.73	29.88	24.32	27.55	47.18	30.34	1.31	8.73
CL# 2(b).39	26.24	14.42	27.32	27.40	27.23	23.16	16.94	13.26	18.83	15.67	6.42	5.01

APPENDIX B.1.6:

Rare earth element ratios derived from trace element concentration values found in Appendix B.1.4. for individual apatite phenocrysts from the Sprout Brook K-bentonite layer CL# 2(b) from Locality A near Cobleskill, New York. Mean, standard deviation, 2 Sigma standard error of the mean, and percent standard deviation values for trace elements are below each ratio.

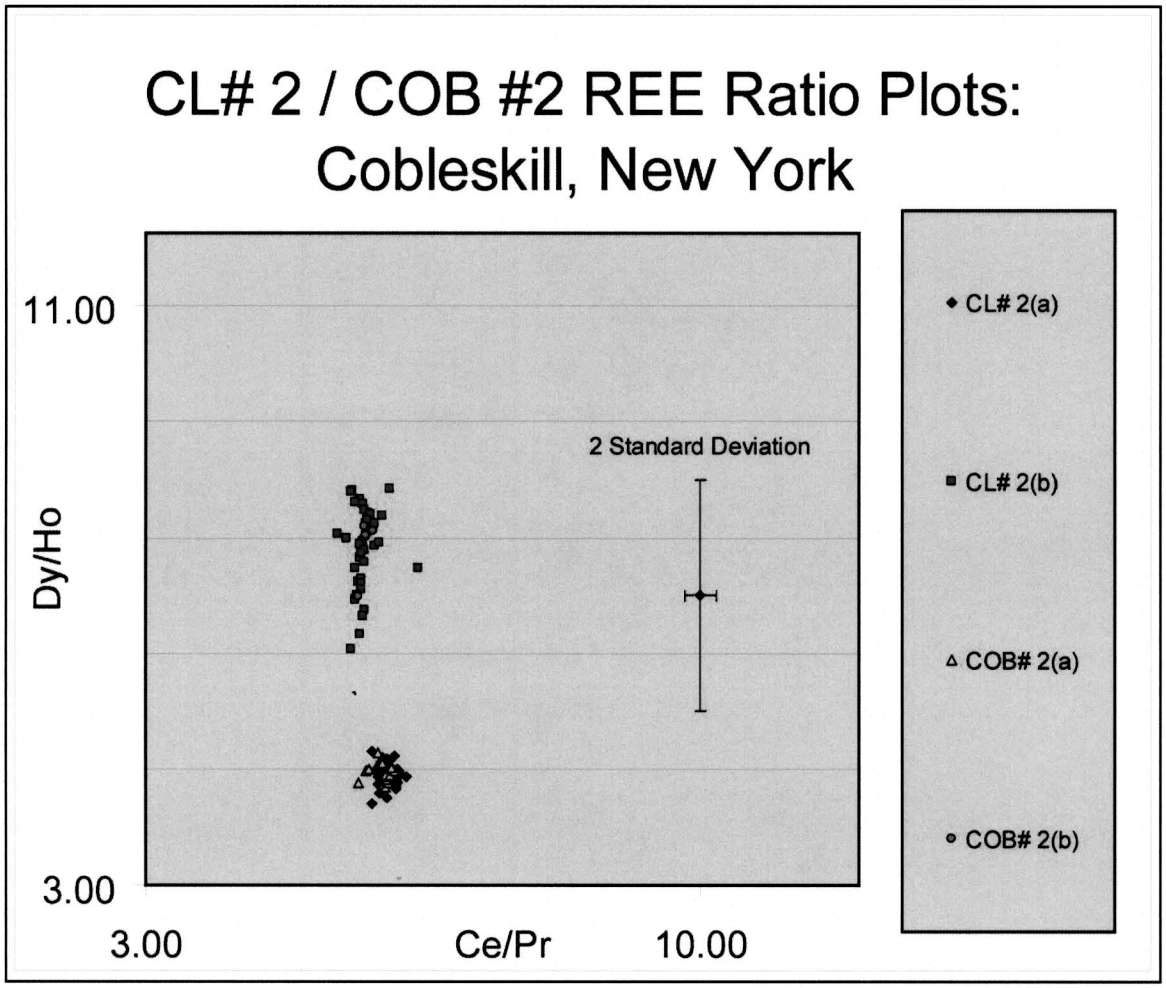
Sample Name	Ce/La	Ce/Pr	Nd/Pr	Nd/Sm	Gd/Sm	Gd/Tb
CL# 2(b).01	2.91	5.70	5.87	3.63	0.97	8.74
CL# 2(b).02	3.01	5.79	5.85	3.54	0.98	8.43
CL# 2(b).03	2.82	5.43	6.17	3.70	0.94	8.77
CL# 2(b).04	3.06	5.74	5.95	3.42	0.95	8.85
CL# 2(b).05	2.92	5.77	5.93	3.57	0.98	8.57
CL# 2(b).06	2.84	5.70	6.17	3.75	0.99	8.52
CL# 2(b).07	2.98	5.87	5.79	3.52	0.99	8.67
CL# 2(b).08	2.93	5.98	5.70	3.55	1.03	8.65
CL# 2(b).09	3.03	5.89	5.50	3.39	1.02	8.68
CL# 2(b).10	3.10	5.75	5.80	3.35	0.96	8.72
CL# 2(b).11	3.01	5.89	5.78	3.49	1.00	8.37
CL# 2(b).12	2.96	5.70	5.80	3.31	0.93	8.82
CL# 2(b).13	2.96	5.60	5.85	3.32	0.96	9.13
CL# 2(b).14	3.08	6.09	5.50	3.15	0.95	9.04
CL# 2(b).15	3.11	5.77	5.68	3.21	0.95	8.88
CL# 2(b).16	2.87	5.79	5.97	3.66	0.99	9.01
CL# 2(b).17	2.85	5.77	5.81	3.48	0.96	8.96
CL# 2(b).18	3.03	5.71	5.77	3.24	0.95	8.87
CL# 2(b).19	3.03	5.84	5.79	3.29	0.93	8.88
CL# 2(b).20	3.04	5.65	5.65	3.28	0.96	8.98
CL# 2(b).21	2.83	5.54	5.92	3.63	1.05	9.33
CL# 2(b).22	2.95	5.81	5.70	3.48	1.04	9.36
CL# 2(b).23	2.99	5.96	5.87	3.49	1.02	9.42
CL# 2(b).24	2.92	5.80	5.80	3.38	0.98	8.87
CL# 2(b).25	3.03	5.76	6.10	3.28	0.94	8.33
CL# 2(b).26	2.99	5.64	6.29	3.15	0.94	8.34
CL# 2(b).27	3.00	5.68	5.96	3.14	0.95	8.46
CL# 2(b).28	3.27	5.60	5.94	2.89	0.89	8.28
CL# 2(b).29	3.14	5.73	5.88	3.04	0.94	8.21
CL# 2(b).30	3.63	6.45	5.63	2.79	0.92	8.80
CL# 2(b).31	3.00	5.73	5.86	3.15	0.93	8.62
CL# 2(b).32	3.00	5.76	7.24	4.03	0.93	8.44
CL# 2(b).33	3.22	5.65	6.01	3.03	0.87	8.57
CL# 2(b).34	3.39	5.74	5.90	2.92	0.90	8.63
CL# 2(b).35	3.18	5.72	5.73	2.88	0.91	8.56
CL# 2(b).36	3.09	5.60	5.99	3.07	0.94	8.73
CL# 2(b).37	3.31	5.70	6.01	2.96	0.88	8.16
CL# 2(b).38	3.03	5.66	5.89	3.05	0.94	8.46
CL# 2(b).39	2.47	5.66	5.88	3.09	0.93	8.21
AVERAGE	3.02	5.76	5.90	3.32	0.96	8.70
St. Deviation	0.18	0.17	0.28	0.28	0.04	0.31
2 Σ of Mean	0.06	0.05	0.09	0.09	0.01	0.10
% St. Deviation	6.06	2.88	4.68	8.35	4.38	3.62

APPENDIX B.1.6 continued

Sample Name	Dy/Tb	Dy/Ho	Er/Ho	Er/Tm	Yb/Tm	Yb/Lu
CL# 2(b).01	3.99	8.32	1.38	12.20	4.40	9.03
CL# 2(b).02	3.95	8.13	1.26	12.73	4.58	8.74
CL# 2(b).03	3.81	7.85	1.41	10.41	4.78	9.22
CL# 2(b).04	3.55	7.75	1.45	12.29	4.52	7.96
CL# 2(b).05	3.82	7.99	1.37	13.75	4.46	8.20
CL# 2(b).06	3.82	7.71	1.27	12.88	4.44	8.26
CL# 2(b).07	3.90	7.96	1.30	13.82	4.91	8.60
CL# 2(b).08	3.96	8.10	1.27	12.78	4.57	9.82
CL# 2(b).09	3.85	8.00	1.22	12.77	5.12	8.93
CL# 2(b).10	3.72	8.26	1.30	13.67	4.16	9.06
CL# 2(b).11	3.60	7.68	1.36	13.37	4.22	8.35
CL# 2(b).12	3.76	7.51	1.48	9.95	4.51	7.34
CL# 2(b).13	3.63	8.46	1.15	10.58	3.88	6.94
CL# 2(b).14	3.66	8.48	1.40	12.72	4.05	7.18
CL# 2(b).15	3.56	8.18	1.46	12.35	3.95	6.85
CL# 2(b).16	3.81	7.83	1.29	11.77	3.90	7.81
CL# 2(b).17	3.84	7.63	1.23	11.86	4.20	7.83
CL# 2(b).18	3.60	7.58	1.48	13.06	4.56	22.58
CL# 2(b).19	3.68	8.12	1.32	13.72	4.15	-67.30
CL# 2(b).20	3.45	8.29	1.23	13.65	4.18	-70.42
CL# 2(b).21	3.74	7.79	1.29	13.04	4.57	10.82
CL# 2(b).22	3.94	8.03	1.30	11.62	3.29	6.97
CL# 2(b).23	3.87	7.74	1.22	11.26	4.10	10.17
CL# 2(b).24	3.80	7.87	1.23	12.58	4.51	9.46
CL# 2(b).25	4.00	7.47	1.48	10.87	4.88	7.81
CL# 2(b).26	4.37	7.38	1.49	8.01	4.72	8.35
CL# 2(b).27	4.02	7.18	1.53	8.93	4.67	7.66
CL# 2(b).28	4.55	8.44	1.61	7.47	4.56	9.18
CL# 2(b).29	4.11	7.23	1.50	9.08	7.49	12.65
CL# 2(b).30	3.75	7.37	1.55	10.50	5.15	7.61
CL# 2(b).31	3.83	7.16	1.35	12.62	5.34	8.65
CL# 2(b).32	3.96	6.79	1.45	10.20	4.74	6.91
CL# 2(b).33	4.05	6.95	1.96	10.13	5.26	8.36
CL# 2(b).34	3.98	6.71	1.64	9.21	5.51	7.89
CL# 2(b).35	3.77	7.09	1.61	9.89	5.17	7.50
CL# 2(b).36	3.82	6.26	1.74	10.90	5.49	10.26
CL# 2(b).37	4.01	6.47	1.45	7.62	8.07	9.05
CL# 2(b).38	3.86	6.99	1.26	12.13	5.64	10.56
CL# 2(b).39	4.02	7.00	1.53	8.99	4.55	7.93
AVERAGE	3.86	7.63	1.41	11.42	4.75	4.94
St. Deviation	0.21	0.57	0.16	1.82	0.87	17.57
2 Σ of Mean	0.07	0.18	0.05	0.58	0.28	5.63
% St. Deviation	5.48	7.44	11.68	15.93	18.41	355.56

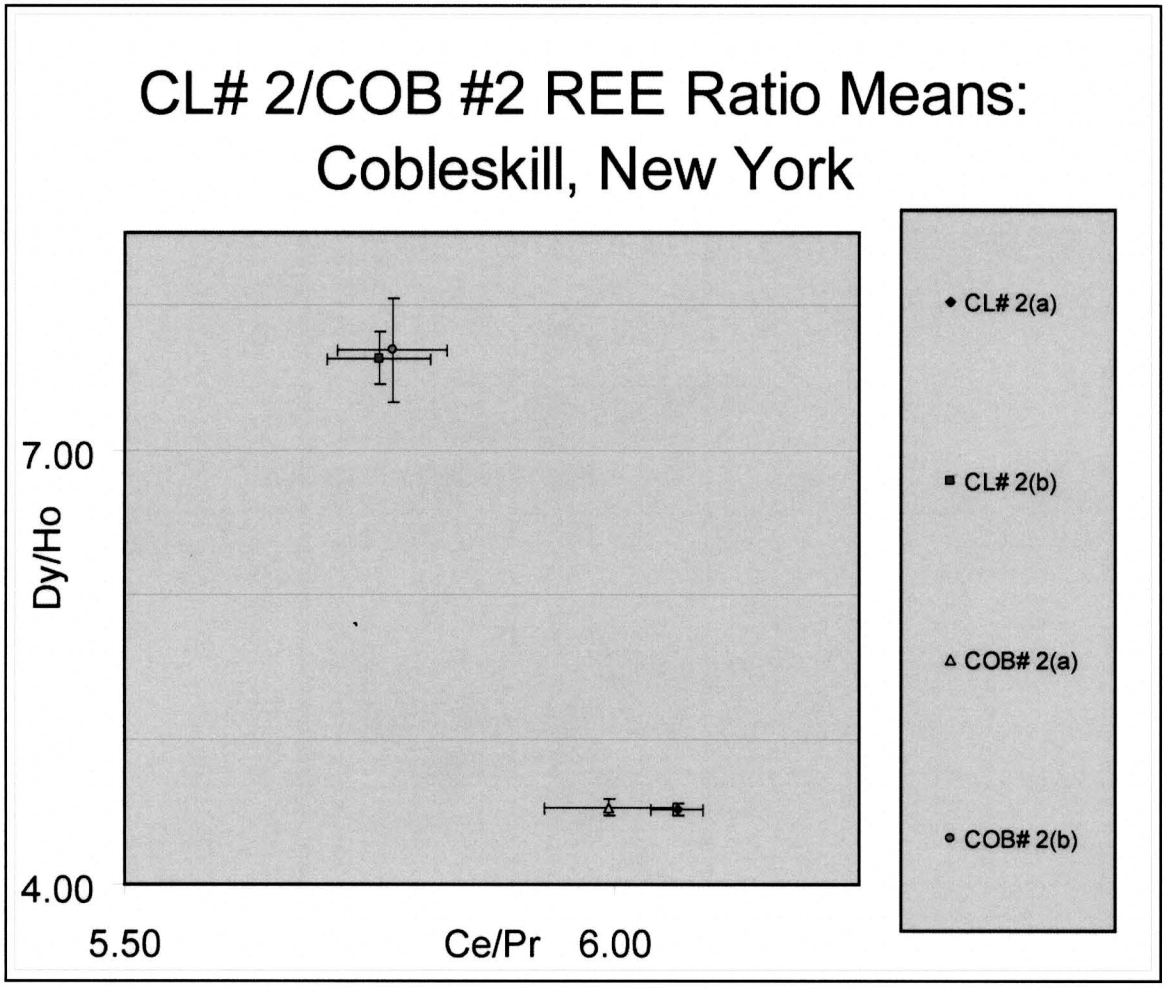
APPENDIX B.1.7:

Rare earth element ratios plots for layer CL# 2 from values listed in APPENDICES B.1.3, and B.1.6, in addition to values generated during identical geochemical analyses performed on grains from the same stratigraphic interval but sampled prior to this study and analyzed by Dr. George H. Shaw at Union College in Schenectady, New York. Plots generated from the K-bentonite layer COB# 2 are shown for analytical corroboration. Data populations have been subdivided and labeled based on similar geochemical ratio values. Scale and legend are given.



APPENDIX B.1.8:

Rare earth element ratios plots for layer CL# 2 from values listed in APPENDICES B.1.3, and B.1.6, in addition to values generated during identical geochemical analyses performed on grains from the same stratigraphic interval but sampled prior to this study and analyzed by Dr. George H. Shaw at Union College in Schenectady, New York. Plots generated from the K-bentonite layer COB# 2 are shown for analytical corroboration. Data populations have been subdivided and labeled based on similar geochemical ratio values. Error bars are 2 Sigma standard error of the mean. Scale has been exaggerated in order to show the separation of plots from one another. Scale and legend are given.



APPENDIX B.2.1:

Trace element concentrations obtained from ICP-MS analysis of individual apatite phenocrysts from within the Sprout Brook K-bentonite layer CL# 3(a) from Cobleskill, New York. Since individual crystal weights could not be measured, values shown have no units. Average, standard deviation, 2 sigma standard error of the mean, and percent standard deviation values are shown below each analyte used in further analyses.

Sample Name	P	Ca	Ca/P*	Sr	Y	La	Ce	Pr	Nd	Sm	Eu
CL# 3(a).01	2522.99	4994.15	0.94	3.08	36.36	6.60	22.63	3.82	22.28	8.76	0.61
CL# 3(a).02	9452.80	19376.08	0.97	10.68	80.72	32.08	95.48	16.82	100.49	34.12	2.03
CL# 3(a).03	1847.73	3748.49	0.96	1.99	24.67	5.90	19.76	3.41	19.37	7.39	0.40
CL# 3(a).04	6337.71	12151.46	0.91	6.44	76.79	18.48	61.61	10.55	60.01	23.04	1.32
CL# 3(a).05	2935.06	5954.75	0.96	2.44	13.11	5.21	15.05	2.46	13.88	4.19	0.52
CL# 3(a).06	7018.53	14633.67	0.99	7.02	86.40	21.77	67.47	12.12	73.90	26.13	1.38
CL# 3(a).07	1811.27	3534.01	0.92	2.49	15.87	6.70	21.58	3.61	20.04	7.40	0.49
CL# 3(a).08	2599.82	5489.28	1.00	3.46	29.03	7.68	24.83	4.23	25.49	9.58	0.61
CL# 3(a).09	3205.92	6643.78	0.98	3.13	44.37	9.95	30.59	5.53	34.98	12.07	0.61
CL# 3(a).10	6487.82	13525.78	0.99	6.34	71.66	20.28	61.55	11.16	68.23	25.82	1.56
CL# 3(a).11	4352.04	8834.54	0.96	4.01	33.51	16.04	47.12	8.08	44.84	15.77	0.76
CL# 3(a).12	4746.17	9619.42	0.96	4.64	54.21	14.03	44.62	7.97	46.79	17.92	1.10
CL# 3(a).13	2937.24	5983.78	0.96	2.04	32.86	9.09	28.27	4.91	27.80	10.27	0.48
CL# 3(a).14	3878.77	7848.64	0.96	2.78	45.31	12.00	36.59	6.40	36.70	13.77	0.61
CL# 3(a).15	2435.86	5303.78	1.03	1.24	10.95	4.43	12.12	2.07	12.63	3.52	0.47
CL# 3(a).16	5541.45	11544.00	0.98	4.71	81.09	17.15	51.41	9.48	55.96	21.56	1.17
CL# 3(a).17	2021.35	4087.26	0.96	1.00	31.15	5.87	17.98	3.18	18.63	6.95	0.27
CL# 3(a).18	4641.30	9271.72	0.94	4.67	31.48	17.31	53.51	9.28	51.77	18.22	0.97
CL# 3(a).19	1697.34	3326.17	0.93	1.24	24.18	5.32	17.07	3.03	18.51	6.90	0.40
CL# 3(a).20	1972.14	4211.60	1.01	1.75	23.55	5.50	17.17	2.96	18.03	6.10	0.33
CL# 3(a).21	1509.25	3098.98	0.97	1.22	21.81	4.18	12.97	2.23	12.13	4.71	0.24
CL# 3(a).22	3809.25	8047.12	1.00	3.80	44.90	11.20	34.25	5.89	34.42	12.48	0.69
CL# 3(a).23	1123.00	2249.62	0.95	0.98	11.37	2.97	9.22	1.57	9.11	2.98	0.17
CL# 3(a).24	4714.85	9686.92	0.97	4.57	55.64	14.40	44.33	7.74	46.30	16.57	0.97
CL# 3(a).25	2593.29	5354.53	0.98	2.15	33.04	8.03	24.63	4.34	24.87	9.12	0.41
CL# 3(a).26	2841.55	5852.02	0.97	2.03	39.85	7.82	24.54	4.24	24.57	9.18	0.36
CL# 3(a).27	4146.58	8312.07	0.95	3.29	47.35	12.06	36.69	6.47	38.09	13.86	0.60
CL# 3(a).28	2141.08	4550.35	1.00	1.78	24.52	6.42	19.73	3.44	19.38	7.42	0.29
CL# 3(a).29	1526.77	3304.89	1.02	0.96	6.48	2.74	7.49	1.22	7.11	2.10	0.26
CL# 3(a).30	5079.61	10763.56	1.00	5.43	59.87	15.20	47.36	8.35	48.16	18.48	1.04
CL# 3(a).31	4825.22	9874.43	0.97	5.03	40.93	16.58	50.78	8.89	51.43	18.94	1.06
CL# 3(a).32	2077.42	4539.39	1.03	1.62	10.20	4.44	11.54	1.95	11.57	3.06	0.35
CL# 3(a).33	4373.31	9246.74	1.00	2.84	16.79	7.08	18.53	3.08	18.66	4.97	0.65
CL# 3(a).34	2511.13	5450.24	1.03	2.30	11.19	4.11	11.59	1.89	10.85	3.28	0.49
CL# 3(a).35	1999.71	4054.38	0.96	2.08	14.07	7.03	21.40	3.77	22.42	7.93	0.44
CL# 3(a).36	2108.82	4368.90	0.98	1.64	22.68	10.39	28.62	4.81	27.69	6.87	0.31
CL# 3(a).37	4836.89	10066.83	0.98	4.78	69.57	13.59	43.11	7.62	45.55	17.50	1.10
CL# 3(a).38	2759.90	5807.19	0.99	2.38	33.86	8.08	24.92	4.37	25.02	9.47	0.45
CL# 3(a).39	894.85	1960.43	1.04	0.78	9.54	2.43	7.45	1.33	7.99	2.68	0.16
		Average		3.20	36.43	10.26	31.42	5.49	32.20	11.57	0.67
		St. Deviation		2.06	22.50	6.35	19.49	3.48	20.70	7.63	0.42
		2 Σ of Mean		0.66	7.21	2.03	6.24	1.11	6.63	2.44	0.14
		% St. Deviation		64.48	61.76	61.86	62.02	63.35	64.31	66.00	63.07

APPENDIX B.2.1 continued

Sample Name	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Pb	Th	U
CL# 3(a).01	10.14	1.55	8.33	1.40	2.39	0.26	1.10	0.12	3.26	2.14	0.44
CL# 3(a).02	36.50	7.67	22.15	3.22	4.42	0.40	1.69	0.20	0.10	3.63	1.13
CL# 3(a).03	8.21	1.22	5.89	0.93	1.36	0.12	0.53	0.06	-0.07	1.23	0.30
CL# 3(a).04	26.30	3.87	18.36	2.92	4.35	0.41	1.62	0.18	0.20	3.15	0.88
CL# 3(a).05	4.09	0.54	2.84	0.54	0.96	0.13	0.65	0.09	-0.17	1.10	0.35
CL# 3(a).06	30.03	4.40	21.27	3.33	4.68	0.44	1.84	0.20	-0.26	2.39	0.88
CL# 3(a).07	7.68	0.99	4.24	0.61	0.86	0.08	0.34	0.04	-0.27	1.07	0.32
CL# 3(a).08	10.72	1.53	7.36	1.19	1.68	0.16	0.66	0.07	2.95	1.37	0.39
CL# 3(a).09	14.06	2.02	10.34	1.67	2.62	0.26	1.04	0.12	-0.06	1.50	0.44
CL# 3(a).10	28.82	4.14	19.65	2.95	4.10	0.36	1.42	0.16	3.29	3.53	0.96
CL# 3(a).11	16.88	2.30	10.40	1.45	2.06	0.17	0.79	0.09	0.27	0.99	0.45
CL# 3(a).12	19.97	2.92	14.14	2.18	3.14	0.29	1.17	0.12	-0.39	2.38	0.59
CL# 3(a).13	11.60	1.65	8.29	1.35	2.06	0.20	0.88	0.10	5.20	0.83	0.31
CL# 3(a).14	15.42	2.33	11.50	1.91	2.98	0.30	1.35	0.15	-0.44	0.89	0.44
CL# 3(a).15	3.48	0.48	2.47	0.48	0.94	0.11	0.57	0.07	-0.54	1.04	0.32
CL# 3(a).16	24.44	3.74	19.40	3.26	5.11	0.52	2.21	0.25	1.15	3.05	0.79
CL# 3(a).17	8.51	1.33	7.13	1.24	2.10	0.22	0.89	0.11	-0.11	0.32	0.16
CL# 3(a).18	19.01	2.49	10.23	1.30	1.66	0.13	0.55	0.07	-0.38	1.64	0.49
CL# 3(a).19	7.85	1.17	5.89	0.95	1.48	0.15	0.63	0.07	-0.62	0.90	0.26
CL# 3(a).20	7.24	1.13	5.56	0.94	1.48	0.16	0.63	0.07	-0.35	1.11	0.22
CL# 3(a).21	5.77	0.92	4.94	0.92	1.54	0.17	0.73	0.08	-0.03	0.53	0.19
CL# 3(a).22	15.07	2.19	10.68	1.85	2.95	0.29	1.23	0.15	0.27	0.93	0.44
CL# 3(a).23	3.31	0.48	2.46	0.49	0.96	0.13	0.58	0.07	0.09	0.35	0.14
CL# 3(a).24	19.86	2.99	14.31	2.25	3.24	0.30	1.18	0.13	1.75	1.34	0.53
CL# 3(a).25	10.44	1.65	7.96	1.38	2.14	0.22	0.86	0.09	-0.17	0.59	0.30
CL# 3(a).26	11.35	1.81	9.33	1.67	2.74	0.29	1.22	0.13	-0.37	0.40	0.23
CL# 3(a).27	16.42	2.47	11.68	1.88	2.73	0.26	1.01	0.11	-0.35	0.87	0.38
CL# 3(a).28	8.63	1.29	6.21	1.02	1.56	0.14	0.55	0.06	1.76	0.41	0.21
CL# 3(a).29	1.97	0.28	1.39	0.28	0.58	0.07	0.32	0.04	-0.78	0.48	0.11
CL# 3(a).30	22.13	3.28	15.10	2.46	3.63	0.33	1.33	0.14	6.59	2.58	0.63
CL# 3(a).31	21.44	2.80	12.02	1.63	2.17	0.18	0.69	0.08	-0.51	2.11	0.67
CL# 3(a).32	3.21	0.42	2.24	0.44	0.88	0.11	0.56	0.07	0.36	0.87	0.22
CL# 3(a).33	5.37	0.69	3.68	0.72	1.46	0.18	0.94	0.11	-0.74	1.04	0.31
CL# 3(a).34	3.65	0.49	2.53	0.47	0.86	0.11	0.51	0.07	0.18	0.93	0.28
CL# 3(a).35	8.93	1.14	4.67	0.54	0.64	0.05	0.21	0.02	-0.98	0.74	0.28
CL# 3(a).36	7.04	0.92	4.79	0.99	2.01	0.25	1.20	0.14	-0.88	0.63	0.21
CL# 3(a).37	21.07	3.18	16.58	2.84	4.62	0.49	2.04	0.23	-0.83	2.42	0.62
CL# 3(a).38	11.69	1.68	8.35	1.37	2.09	0.20	0.74	0.09	-0.44	0.63	0.28
CL# 3(a).39	2.98	0.41	2.04	0.40	0.76	0.10	0.49	0.06	1.12	0.30	0.11
Average	13.11	1.96	9.14	1.47	2.26	0.22	0.95	0.11	0.48	1.34	0.42
St. Deviation	8.58	1.47	5.81	0.89	1.26	0.12	0.48	0.05	1.67	0.93	0.25
2 Σ of Mean	2.75	0.47	1.86	0.28	0.40	0.04	0.15	0.02	0.54	0.30	0.08
% St. Deviation	65.45	74.72	63.53	60.37	55.93	52.96	50.43	48.76	347.97	68.89	59.35

APPENDIX B.2.2:

Percent relative standard deviation values for each element analyzed during ICP-MS analysis of individual apatite phenocrysts from within Sprout Brook K-bentonite layer CL# 3(a) from Cobleskill, New York. These percent values are generated during 5 replicate analyses of each individual crystal analyzed.

Sample Name	P	Ca	Sr	Y	La	Ce	Pr	Nd	Sm
CL# 3(a).01	5.91	7.75	0.68	3.68	3.08	3.82	2.74	4.87	2.97
CL# 3(a).02	4.26	1.34	1.93	1.67	2.11	0.95	2.18	6.44	2.73
CL# 3(a).03	3.55	7.51	1.58	2.10	1.65	2.20	2.77	4.77	2.24
CL# 3(a).04	2.66	2.58	2.76	2.04	3.12	3.24	2.58	3.60	3.38
CL# 3(a).05	2.54	2.86	2.96	5.24	1.82	1.21	2.15	4.43	3.13
CL# 3(a).06	4.58	2.77	3.14	3.11	1.80	1.77	3.09	3.30	2.18
CL# 3(a).07	4.77	4.87	0.66	2.06	3.59	1.48	2.35	4.10	3.20
CL# 3(a).08	3.96	4.54	3.37	4.18	3.48	3.28	1.51	2.93	1.46
CL# 3(a).09	2.30	2.52	1.51	1.47	3.56	1.43	2.14	4.91	1.68
CL# 3(a).10	1.74	1.28	1.41	2.01	1.79	1.97	1.30	2.53	2.15
CL# 3(a).11	2.11	1.52	1.58	1.80	1.43	1.15	2.64	3.12	0.86
CL# 3(a).12	5.59	4.77	2.88	4.30	1.27	1.55	1.78	4.83	2.01
CL# 3(a).13	4.87	3.44	1.62	2.99	1.74	0.90	1.04	4.76	3.59
CL# 3(a).14	2.75	3.31	2.17	1.93	1.89	1.41	1.28	4.66	2.97
CL# 3(a).15	4.32	5.77	4.86	3.63	2.40	1.55	2.08	6.80	3.62
CL# 3(a).16	3.44	2.87	1.37	4.33	2.61	2.74	2.93	2.89	1.90
CL# 3(a).17	2.94	4.20	2.10	1.45	3.13	3.09	2.27	7.45	3.91
CL# 3(a).18	2.07	2.52	3.18	2.43	3.37	2.00	1.18	2.91	2.45
CL# 3(a).19	5.19	7.39	5.71	1.83	2.28	2.98	2.68	4.51	2.89
CL# 3(a).20	26.31	12.05	1.43	3.30	5.33	1.15	1.44	7.22	3.14
CL# 3(a).21	41.72	14.69	3.03	3.03	1.30	2.60	1.07	7.45	4.16
CL# 3(a).22	9.97	5.53	2.37	2.87	2.39	3.03	0.76	3.92	2.60
CL# 3(a).23	52.15	15.17	2.40	3.91	1.68	3.97	2.88	5.30	2.35
CL# 3(a).24	8.31	5.33	3.03	2.19	1.05	1.94	2.95	3.51	1.60
CL# 3(a).25	18.09	7.01	2.55	2.55	2.22	2.12	3.35	5.49	2.49
CL# 3(a).26	18.86	6.17	3.22	2.18	2.67	1.91	1.42	2.52	2.46
CL# 3(a).27	12.66	7.09	1.29	2.38	1.85	2.41	1.28	2.05	3.96
CL# 3(a).28	17.65	9.46	1.89	3.03	3.86	3.12	2.95	6.98	3.76
CL# 3(a).29	27.22	11.07	3.33	2.85	3.85	3.15	4.40	9.08	6.62
CL# 3(a).30	12.15	3.07	1.63	2.22	3.64	3.99	3.58	5.84	4.01
CL# 3(a).31	11.96	4.90	1.44	5.41	2.86	2.55	1.72	1.95	1.25
CL# 3(a).32	24.31	11.85	3.38	3.43	2.64	2.26	2.93	3.32	6.79
CL# 3(a).33	12.05	5.14	2.43	1.45	1.62	2.20	1.62	2.45	2.51
CL# 3(a).34	19.02	7.75	2.50	1.81	2.19	3.29	1.94	8.26	1.40
CL# 3(a).35	25.80	8.83	3.34	2.05	4.17	3.25	3.48	2.85	3.94
CL# 3(a).36	31.63	11.51	1.44	2.07	2.40	1.94	1.30	1.67	2.09
CL# 3(a).37	12.22	5.01	1.35	2.86	2.08	0.95	1.98	6.42	3.34
CL# 3(a).38	17.16	9.89	1.88	3.89	1.32	2.41	4.02	6.27	3.61
CL# 3(a).39	49.87	22.92	2.06	5.87	3.00	3.05	3.67	5.33	4.25

APPENDIX B.2.2 continued

Sample Name	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Pb	Th	U
CL# 3(a).01	2.90	2.94	1.02	8.77	2.90	5.04	5.24	7.12	6.48	4.46	6.69	10.74
CL# 3(a).02	1.10	1.79	75.86	3.88	2.40	4.08	3.75	3.67	3.87	47.71	6.57	3.49
CL# 3(a).03	6.44	4.22	2.29	3.92	5.15	5.35	6.85	6.21	12.46	178.87	8.24	16.17
CL# 3(a).04	3.33	1.34	2.05	1.06	1.07	5.57	2.22	3.88	5.07	33.32	5.61	5.21
CL# 3(a).05	2.16	2.95	3.01	3.49	9.46	5.14	5.09	4.13	8.14	30.61	6.40	4.92
CL# 3(a).06	2.55	2.53	1.03	3.25	1.06	5.78	2.11	2.39	4.09	22.83	7.01	1.76
CL# 3(a).07	4.22	2.98	0.45	4.24	3.82	7.59	10.71	5.53	4.01	27.65	5.30	3.77
CL# 3(a).08	2.21	2.64	1.22	4.05	2.68	7.64	5.04	6.37	5.91	3.96	7.93	2.39
CL# 3(a).09	4.06	3.30	2.43	2.30	3.46	10.27	4.15	4.33	7.32	77.71	7.59	7.30
CL# 3(a).10	0.86	1.31	2.43	1.53	2.68	4.40	3.33	1.98	4.24	3.58	2.69	3.03
CL# 3(a).11	5.90	2.14	2.39	3.59	5.09	4.90	4.71	6.69	9.44	21.40	7.63	8.50
CL# 3(a).12	3.89	3.61	1.56	1.92	1.89	3.93	3.75	8.57	6.08	10.70	4.43	3.63
CL# 3(a).13	3.58	3.64	2.04	2.32	1.64	4.85	4.70	3.17	9.01	1.59	5.39	3.21
CL# 3(a).14	4.78	2.05	2.99	1.87	1.51	4.85	3.70	3.42	4.47	5.98	2.49	2.91
CL# 3(a).15	2.77	4.30	3.14	5.05	5.41	9.33	4.67	7.76	7.79	6.48	3.34	30.43
CL# 3(a).16	3.94	1.89	3.50	3.17	2.51	2.14	3.33	2.66	3.20	2.76	3.11	1.97
CL# 3(a).17	7.49	1.51	1.83	1.82	3.10	4.40	3.93	3.80	3.91	50.27	12.91	8.07
CL# 3(a).18	1.99	2.46	1.40	1.50	2.97	5.62	5.83	6.31	4.46	7.59	4.87	5.51
CL# 3(a).19	4.03	1.03	1.25	3.99	3.06	4.68	4.00	4.63	5.40	5.51	4.94	6.80
CL# 3(a).20	5.15	4.07	5.19	7.39	1.83	4.96	2.13	2.85	9.66	28.71	62.18	5.54
CL# 3(a).21	5.36	3.52	2.50	3.14	2.95	3.15	4.23	4.83	10.52	158.87	20.70	7.15
CL# 3(a).22	4.51	1.57	2.36	2.87	1.41	3.65	4.50	4.73	4.48	24.37	6.66	3.31
CL# 3(a).23	6.79	3.80	2.24	3.09	2.93	6.08	7.58	8.25	10.93	58.43	13.16	4.84
CL# 3(a).24	2.19	4.47	1.65	2.11	1.93	1.64	2.55	5.31	7.73	2.70	4.46	3.98
CL# 3(a).25	6.55	3.14	3.19	3.29	2.56	6.50	10.25	5.98	6.03	39.17	7.40	3.34
CL# 3(a).26	5.06	4.22	1.78	2.77	2.64	4.95	5.58	2.65	4.41	15.16	4.30	7.37
CL# 3(a).27	4.60	3.89	1.53	2.06	1.92	6.27	4.00	6.72	4.88	13.52	7.96	7.29
CL# 3(a).28	4.95	2.50	3.03	1.75	2.24	5.96	5.35	3.96	4.95	7.00	10.77	7.84
CL# 3(a).29	2.73	7.26	1.68	5.05	13.72	4.25	7.05	8.68	13.88	4.52	5.84	7.26
CL# 3(a).30	4.20	4.03	2.23	0.52	1.85	4.59	3.48	3.23	4.39	2.96	37.17	1.61
CL# 3(a).31	2.48	2.34	3.75	4.29	2.34	5.30	7.01	5.33	6.87	10.96	5.03	4.49
CL# 3(a).32	4.41	5.90	5.15	7.30	4.78	7.58	5.70	6.17	8.29	25.86	9.88	5.94
CL# 3(a).33	2.59	3.76	4.77	4.85	5.48	6.87	6.38	5.72	3.94	4.99	3.62	2.84
CL# 3(a).34	3.75	3.25	2.93	4.26	4.48	4.85	7.54	7.44	3.00	27.64	3.23	1.73
CL# 3(a).35	6.47	5.47	4.22	2.83	6.86	11.88	9.66	14.42	5.75	5.88	5.94	4.53
CL# 3(a).36	5.90	3.50	3.35	3.94	4.59	3.76	2.73	9.41	5.50	3.23	8.01	4.52
CL# 3(a).37	2.38	0.99	3.21	4.51	3.04	3.65	3.79	4.34	5.42	3.30	6.53	7.05
CL# 3(a).38	5.43	4.33	2.43	2.31	2.27	5.17	1.68	5.46	9.82	17.56	6.53	5.39
CL# 3(a).39	6.40	5.73	3.14	2.41	6.40	6.83	3.53	8.36	6.38	9.64	6.99	3.69

APPENDIX B.2.3:

Rare earth element ratios derived from trace element concentration values found in Appendix B.2.1. for individual apatite phenocrysts from the Sprout Brook K-bentonite layer CL# 3(a) from Locality A near Cobleskill, New York. Mean, standard deviation, 2 Sigma standard error of the mean, and percent standard deviation values for trace elements are below each ratio.

Sample Name	Ce/La	Ce/Pr	Nd/Pr	Nd/Sm	Gd/Sm	Gd/Tb
CL# 3(a).01	3.43	5.92	5.83	2.54	1.16	6.53
CL# 3(a).02	2.98	5.68	5.97	2.95	1.07	4.76
CL# 3(a).03	3.35	5.80	5.68	2.62	1.11	6.75
CL# 3(a).04	3.33	5.84	5.69	2.61	1.14	6.80
CL# 3(a).05	2.89	6.12	5.65	3.31	0.97	7.53
CL# 3(a).06	3.10	5.57	6.10	2.83	1.15	6.82
CL# 3(a).07	3.22	5.97	5.55	2.71	1.04	7.72
CL# 3(a).08	3.23	5.87	6.02	2.66	1.12	6.99
CL# 3(a).09	3.07	5.53	6.32	2.90	1.16	6.96
CL# 3(a).10	3.04	5.52	6.11	2.64	1.12	6.97
CL# 3(a).11	2.94	5.83	5.55	2.84	1.07	7.35
CL# 3(a).12	3.18	5.60	5.87	2.61	1.11	6.84
CL# 3(a).13	3.11	5.76	5.66	2.71	1.13	7.02
CL# 3(a).14	3.05	5.72	5.73	2.66	1.12	6.63
CL# 3(a).15	2.74	5.87	6.11	3.59	0.99	7.32
CL# 3(a).16	3.00	5.42	5.90	2.60	1.13	6.53
CL# 3(a).17	3.06	5.65	5.85	2.68	1.22	6.41
CL# 3(a).18	3.09	5.76	5.58	2.84	1.04	7.63
CL# 3(a).19	3.21	5.63	6.11	2.68	1.14	6.73
CL# 3(a).20	3.12	5.81	6.10	2.96	1.19	6.43
CL# 3(a).21	3.11	5.80	5.43	2.57	1.22	6.26
CL# 3(a).22	3.06	5.82	5.85	2.76	1.21	6.89
CL# 3(a).23	3.10	5.86	5.79	3.06	1.11	6.83
CL# 3(a).24	3.08	5.73	5.98	2.79	1.20	6.64
CL# 3(a).25	3.07	5.67	5.73	2.73	1.15	6.33
CL# 3(a).26	3.14	5.79	5.80	2.68	1.24	6.28
CL# 3(a).27	3.04	5.67	5.89	2.75	1.18	6.64
CL# 3(a).28	3.07	5.74	5.63	2.61	1.16	6.71
CL# 3(a).29	2.73	6.14	5.84	3.39	0.94	7.01
CL# 3(a).30	3.12	5.67	5.77	2.61	1.20	6.74
CL# 3(a).31	3.06	5.71	5.78	2.72	1.13	7.66
CL# 3(a).32	2.60	5.93	5.94	3.78	1.05	7.66
CL# 3(a).33	2.62	6.02	6.07	3.76	1.08	7.80
CL# 3(a).34	2.82	6.12	5.73	3.31	1.11	7.44
CL# 3(a).35	3.05	5.68	5.95	2.83	1.13	7.84
CL# 3(a).36	2.75	5.96	5.76	4.03	1.02	7.63
CL# 3(a).37	3.17	5.66	5.98	2.60	1.20	6.62
CL# 3(a).38	3.08	5.71	5.73	2.64	1.23	6.96
CL# 3(a).39	3.06	5.59	6.00	2.98	1.11	7.24
AVERAGE	3.05	5.77	5.85	2.89	1.12	6.92
St. Deviation	0.18	0.17	0.19	0.37	0.07	0.58
2 Σ of Mean	0.06	0.05	0.06	0.12	0.02	0.18
% St. Deviation	5.94	2.90	3.31	12.94	6.37	8.34

APPENDIX B.2.3 continued

Sample Name	Dy/Tb	Dy/Ho	Er/Ho	Er/Tm	Yb/Tm	Yb/Lu
CL# 3(a).01	5.36	5.95	1.71	9.11	4.18	8.92
CL# 3(a).02	2.89	6.88	1.37	10.96	4.18	8.46
CL# 3(a).03	4.84	6.33	1.46	10.96	4.30	9.27
CL# 3(a).04	4.75	6.28	1.49	10.53	3.93	9.04
CL# 3(a).05	5.23	5.25	1.77	7.35	4.96	7.42
CL# 3(a).06	4.83	6.38	1.40	10.54	4.15	9.11
CL# 3(a).07	4.26	6.98	1.42	11.22	4.40	8.07
CL# 3(a).08	4.80	6.20	1.41	10.60	4.19	9.15
CL# 3(a).09	5.11	6.18	1.57	10.27	4.10	8.90
CL# 3(a).10	4.75	6.67	1.39	11.50	3.98	8.66
CL# 3(a).11	4.53	7.17	1.42	11.79	4.53	8.90
CL# 3(a).12	4.84	6.48	1.44	10.75	4.03	9.40
CL# 3(a).13	5.02	6.15	1.53	10.14	4.35	8.56
CL# 3(a).14	4.94	6.03	1.56	9.82	4.44	9.21
CL# 3(a).15	5.19	5.18	1.97	8.29	5.03	8.27
CL# 3(a).16	5.18	5.95	1.57	9.76	4.21	8.71
CL# 3(a).17	5.37	5.73	1.69	9.41	4.01	8.42
CL# 3(a).18	4.10	7.88	1.28	12.88	4.29	7.83
CL# 3(a).19	5.05	6.19	1.55	10.07	4.31	9.14
CL# 3(a).20	4.94	5.92	1.57	9.38	3.99	8.76
CL# 3(a).21	5.36	5.37	1.68	9.10	4.29	9.60
CL# 3(a).22	4.89	5.77	1.59	10.21	4.24	8.25
CL# 3(a).23	5.09	5.03	1.96	7.49	4.54	8.28
CL# 3(a).24	4.78	6.37	1.44	10.67	3.90	9.25
CL# 3(a).25	4.82	5.77	1.55	9.78	3.95	9.22
CL# 3(a).26	5.16	5.59	1.65	9.52	4.22	9.42
CL# 3(a).27	4.72	6.21	1.45	10.61	3.92	9.45
CL# 3(a).28	4.83	6.08	1.53	11.07	3.89	8.90
CL# 3(a).29	4.93	4.93	2.06	8.32	4.61	7.54
CL# 3(a).30	4.60	6.13	1.47	11.07	4.06	9.63
CL# 3(a).31	4.29	7.36	1.33	12.14	3.86	8.39
CL# 3(a).32	5.35	5.14	2.02	7.81	4.96	7.83
CL# 3(a).33	5.34	5.10	2.02	7.99	5.12	8.18
CL# 3(a).34	5.17	5.39	1.83	8.14	4.87	7.83
CL# 3(a).35	4.10	8.61	1.18	13.95	4.49	8.79
CL# 3(a).36	5.18	4.85	2.04	8.14	4.87	8.30
CL# 3(a).37	5.21	5.83	1.63	9.39	4.14	9.02
CL# 3(a).38	4.97	6.12	1.53	10.20	3.59	8.50
CL# 3(a).39	4.95	5.09	1.89	7.59	4.87	8.62
AVERAGE	4.87	6.07	1.60	9.96	4.31	8.70
St. Deviation	0.46	0.81	0.23	1.50	0.37	0.57
2 Σ of Mean	0.15	0.26	0.07	0.48	0.12	0.18
% St. Deviation	9.52	13.27	14.18	15.07	8.68	6.54

APPENDIX B.2.4:

Trace element concentrations obtained from ICP-MS analysis of individual apatite phenocrysts from within the Sprout Brook K-bentonite layer CL# 3(b) from Cobleskill, New York. Since individual crystal weights could not be measured, values shown have no units. Average, standard deviation, 2 sigma standard error of the mean, and percent standard deviation values are shown below each analyte used in further analyses.

Sample Name	P	Ca	Ca/P*	Sr	Y	La	Ce	Pr	Nd	Sm	Eu
CL# 3(b).01	5607.76	11084.34	0.93	6.14	80.02	15.64	49.68	8.66	53.05	19.96	1.26
CL# 3(b).02	4768.78	9237.09	0.92	4.98	55.50	13.99	43.15	7.71	46.91	17.02	0.98
CL# 3(b).03	8926.48	17877.03	0.95	12.64	79.13	30.58	94.81	16.85	96.36	35.23	2.09
CL# 3(b).04	3954.96	7403.85	0.89	4.18	56.90	11.28	35.13	6.37	36.88	14.29	0.89
CL# 3(b).05	5293.34	9757.63	0.87	4.95	66.96	16.37	52.10	9.15	53.46	20.75	1.09
CL# 3(b).06	4363.27	7935.71	0.86	3.97	51.44	13.50	42.03	7.45	43.07	16.27	0.86
CL# 3(b).07	2209.78	4287.52	0.92	3.09	10.27	4.09	11.08	1.90	11.01	3.18	0.45
CL# 3(b).08	5070.50	9533.47	0.89	4.85	61.56	15.80	47.82	8.45	49.23	17.80	0.90
CL# 3(b).09	2810.58	4810.60	0.81	2.72	34.97	9.16	27.87	5.05	30.39	11.28	0.68
CL# 3(b).10	8376.69	16281.89	0.92	8.17	107.32	26.85	83.62	14.92	89.24	33.56	1.95
CL# 3(b).11	6899.01	13940.19	0.96	7.29	62.59	22.93	72.10	12.72	77.30	28.02	1.67
CL# 3(b).12	1934.16	3989.77	0.98	2.54	23.49	6.03	18.30	3.32	19.97	7.40	0.43
CL# 3(b).13	6006.23	11482.43	0.90	5.76	67.61	18.92	58.74	10.26	61.65	22.79	1.35
CL# 3(b).14	5183.67	9920.16	0.90	6.10	41.89	18.80	55.93	9.89	58.35	20.19	1.26
CL# 3(b).15	3734.60	6936.70	0.88	3.99	29.43	13.28	40.66	7.08	40.20	14.72	0.80
CL# 3(b).16	10243.78	19135.99	0.88	10.51	82.22	35.37	106.18	18.49	104.03	36.69	2.04
CL# 3(b).17	8409.96	16059.92	0.90	7.73	109.12	25.09	78.25	14.00	83.95	31.62	1.81
CL# 3(b).18	2534.00	4109.53	0.77	2.20	28.17	7.61	22.91	4.06	24.60	9.14	0.48
CL# 3(b).19	2351.57	3972.63	0.80	2.50	33.30	7.69	23.86	4.23	25.02	9.15	0.55
CL# 3(b).20	14475.31	27650.15	0.90	14.99	135.26	49.16	146.79	25.51	146.00	51.86	2.87
		Average		5.97	60.86	18.11	55.55	9.80	57.54	21.05	1.22
		St. Deviation		3.46	31.79	11.08	33.48	5.84	33.42	12.00	0.66
		2 Σ of Mean		1.55	14.22	4.95	14.97	2.61	14.94	5.37	0.30
		% St. Deviation		58.03	52.24	61.17	60.27	59.59	58.08	57.02	54.27

APPENDIX B.2.4 continued

Sample Name	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Pb	Th	U
CL# 3(b).01	23.61	3.67	19.47	3.32	5.28	0.57	2.45	0.26	-0.39	3.08	0.87
CL# 3(b).02	19.58	2.89	14.13	2.21	3.38	0.32	1.29	0.14	0.20	1.88	0.52
CL# 3(b).03	39.83	5.21	23.12	3.12	4.42	0.38	1.54	0.18	-1.68	4.27	1.35
CL# 3(b).04	16.88	2.60	13.28	2.25	3.57	0.37	1.54	0.18	-1.24	1.91	0.70
CL# 3(b).05	24.63	3.39	16.33	2.59	3.83	0.34	1.46	0.16	-2.61	2.42	0.64
CL# 3(b).06	19.33	2.73	13.38	2.10	3.13	0.29	1.15	0.13	-2.17	1.28	0.52
CL# 3(b).07	3.36	0.44	2.15	0.43	0.84	0.10	0.51	0.07	-0.22	0.87	0.25
CL# 3(b).08	21.10	3.04	15.61	2.60	4.10	0.42	1.82	0.21	-2.42	1.10	0.59
CL# 3(b).09	13.00	1.84	9.13	1.44	2.02	0.19	0.76	0.09	-1.90	1.48	0.39
CL# 3(b).10	38.31	5.51	26.61	4.15	6.13	0.59	2.33	0.25	-1.30	4.63	1.35
CL# 3(b).11	31.12	4.12	17.84	2.43	3.24	0.27	1.13	0.15	0.00	3.44	1.09
CL# 3(b).12	8.48	1.21	5.89	0.95	1.36	0.13	0.55	0.07	0.00	0.91	0.27
CL# 3(b).13	26.60	3.80	17.72	2.72	4.05	0.36	1.47	0.17	0.00	2.41	0.87
CL# 3(b).14	22.45	2.89	12.39	1.65	2.25	0.19	0.79	0.10	0.00	2.54	0.70
CL# 3(b).15	15.59	2.10	8.81	1.20	1.55	0.13	0.57	0.07	0.00	1.29	0.44
CL# 3(b).16	39.62	5.45	23.20	3.40	4.64	0.40	1.74	0.21	0.00	3.24	1.14
CL# 3(b).17	36.84	5.33	26.65	4.49	6.90	0.70	2.88	0.33	0.00	3.52	1.00
CL# 3(b).18	10.49	1.51	7.43	1.15	1.76	0.16	0.64	0.07	0.00	0.76	0.31
CL# 3(b).19	10.67	1.56	7.40	1.20	1.80	0.16	0.64	0.07	0.00	1.00	0.33
CL# 3(b).20	63.98	7.94	35.76	5.24	7.39	0.63	2.69	0.32	0.00	5.10	1.96
Average	24.27	3.36	15.82	2.43	3.58	0.34	1.40	0.16	-0.69	2.36	0.76
St. Deviation	14.22	1.83	8.30	1.26	1.85	0.18	0.74	0.08	0.97	1.34	0.44
2 Σ of Mean	6.36	0.82	3.71	0.56	0.83	0.08	0.33	0.04	0.43	0.60	0.20
% St. Deviation	58.57	54.31	52.47	51.73	51.59	52.86	53.17	51.39	-141.21	56.71	58.14

APPENDIX B.2.5:

Percent relative standard deviation values for each element analyzed during ICP-MS analysis of individual apatite phenocrysts from within Sprout Brook K-bentonite layer CL# 3(a) from Cobleskill, New York. These percent values are generated during 5 replicate analyses of each individual crystal analyzed.

Sample Name	P	Ca	Sr	Y	La	Ce	Pr	Nd	Sm
CL# 3(b).01	2.58	3.35	1.90	2.78	1.52	1.57	2.32	3.79	2.27
CL# 3(b).02	3.71	4.97	2.24	2.99	0.57	1.10	2.49	3.68	4.34
CL# 3(b).03	4.72	3.75	55.86	2.95	2.03	1.15	1.21	2.13	0.98
CL# 3(b).04	2.69	3.15	2.48	1.67	3.13	5.44	4.29	1.32	3.29
CL# 3(b).05	3.37	5.12	3.23	3.21	3.11	3.05	3.01	3.58	5.15
CL# 3(b).06	1.04	2.57	2.08	2.04	2.10	1.67	2.17	2.66	4.03
CL# 3(b).07	3.08	6.58	3.98	4.78	3.44	4.19	2.36	4.95	2.78
CL# 3(b).08	2.40	3.53	0.91	2.79	1.40	0.81	1.97	3.28	2.73
CL# 3(b).09	2.05	2.76	1.94	2.46	1.68	1.35	1.95	4.68	4.75
CL# 3(b).10	1.86	2.91	1.87	2.49	1.11	2.26	1.70	3.12	1.76
CL# 3(b).11	2.90	2.19	1.99	3.39	1.19	1.83	1.49	2.60	2.66
CL# 3(b).12	4.62	3.75	3.08	3.25	2.49	2.96	3.77	5.04	2.98
CL# 3(b).13	5.10	3.96	3.46	3.38	1.57	2.14	1.10	5.04	2.06
CL# 3(b).14	4.02	2.79	3.24	4.27	1.45	2.61	2.41	3.58	2.06
CL# 3(b).15	3.78	4.45	1.28	1.80	2.26	2.19	2.06	3.03	1.60
CL# 3(b).16	2.11	1.83	1.93	3.14	0.59	2.90	2.04	3.40	2.04
CL# 3(b).17	3.20	3.62	1.73	4.04	1.26	0.95	2.61	3.79	1.97
CL# 3(b).18	2.81	4.21	3.99	5.80	3.33	2.93	4.96	3.02	4.57
CL# 3(b).19	3.26	7.23	3.05	28.22	0.50	2.95	1.52	5.96	3.10
CL# 3(b).20	2.35	1.97	1.04	16.11	1.84	1.41	1.93	3.11	2.03

Sample Name	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Pb	Th	U
CL# 3(b).01	3.85	3.95	1.57	1.43	4.03	4.94	3.03	4.75	5.64	11.63	8.45	5.84
CL# 3(b).02	5.43	3.21'	1.62	3.76	4.27	5.48	2.98	6.24	5.05	59.60	2.86	5.25
CL# 3(b).03	2.50	2.00	3.05	3.61	2.75	3.98	4.23	3.68	5.41	5.37	11.13	4.23
CL# 3(b).04	1.79	2.73	2.25	3.63	0.36	2.28	5.21	2.07	10.88	7.97	5.41	5.33
CL# 3(b).05	3.92	3.66	0.84	1.77	1.77	2.66	2.96	2.02	9.08	1.74	3.89	6.31
CL# 3(b).06	1.08	2.73	2.08	4.48	3.77	7.36	5.15	3.67	9.51	2.57	2.98	5.04
CL# 3(b).07	3.13	3.91	4.52	3.67	3.00	10.71	7.65	4.36	7.25	37.52	3.42	8.06
CL# 3(b).08	3.74	2.53	1.04	2.88	1.68	4.88	4.07	3.89	7.64	1.83	5.87	4.46
CL# 3(b).09	2.38	2.41	2.59	3.15	3.24	1.53	8.16	7.21	14.74	2.81	4.99	4.56
CL# 3(b).10	1.43	1.34	1.70	1.64	0.96	3.59	2.52	4.96	5.87	2.69	2.04	6.50
CL# 3(b).11	2.50	3.43	2.46	3.75	2.94	3.21	2.69	7.25	4.87	9.29	4.69	6.31
CL# 3(b).12	6.25	3.54	3.24	3.94	3.94	4.80	6.51	7.00	10.39	5.32	3.23	18.32
CL# 3(b).13	1.75	2.09	3.48	1.43	2.33	6.06	3.45	5.45	5.47	5.27	6.89	16.22
CL# 3(b).14	4.52	3.61	1.58	4.56	3.12	5.64	6.06	3.25	4.27	1.44	7.16	1.19
CL# 3(b).15	2.22	2.62	2.08	4.73	4.10	4.96	5.98	6.73	4.49	2.50	6.84	3.31
CL# 3(b).16	2.90	3.07	2.01	3.11	2.42	3.50	1.33	2.60	5.25	5.77	8.47	2.00
CL# 3(b).17	3.84	3.41	2.88	3.05	3.49	2.22	6.25	2.76	1.78	6.25	9.00	3.88
CL# 3(b).18	2.97	6.69	1.98	2.67	3.97	4.21	7.28	7.71	5.44	1.55	7.20	3.93
CL# 3(b).19	4.94	1.64	3.49	4.03	2.27	3.93	4.45	2.09	8.31	3.30	9.62	3.75
CL# 3(b).20	1.15	18.97	2.58	2.47	2.20	3.40	3.00	3.96	5.58	7.76	8.79	4.61

APPENDIX B.2.6:

Rare earth element ratios derived from trace element concentration values found in Appendix B.2.4. for individual apatite phenocrysts from the Sprout Brook K-bentonite layer CL# 3(b) from Locality A near Cobleskill, New York. Mean, standard deviation, 2 Sigma standard error of the mean, and percent standard deviation values for trace elements are below each ratio.

Sample Name	Ce/La	Ce/Pr	Nd/Pr	Nd/Sm	Gd/Sm	Gd/Tb	Dy/Tb	Dy/Ho	Er/Ho	Er/Tm	Yb/Tm	Yb/Lu
CL# 3(b).01	3.18	5.74	6.13	2.66	1.18	6.43	5.30	5.87	1.59	9.19	4.27	9.34
CL# 3(b).02	3.08	5.60	6.09	2.76	1.15	6.77	4.89	6.40	1.53	10.62	4.04	9.39
CL# 3(b).03	3.10	5.63	5.72	2.74	1.13	7.64	4.44	7.42	1.42	11.71	4.07	8.44
CL# 3(b).04	3.12	5.51	5.79	2.58	1.18	6.49	5.10	5.90	1.59	9.67	4.18	8.67
CL# 3(b).05	3.18	5.69	5.84	2.58	1.19	7.26	4.81	6.30	1.48	11.18	4.25	9.28
CL# 3(b).06	3.11	5.64	5.78	2.65	1.19	7.07	4.89	6.37	1.49	10.97	4.02	8.78
CL# 3(b).07	2.71	5.84	5.80	3.46	1.06	7.69	4.92	4.99	1.95	8.28	4.98	7.65
CL# 3(b).08	3.03	5.66	5.82	2.77	1.19	6.94	5.13	6.00	1.58	9.70	4.30	8.82
CL# 3(b).09	3.04	5.52	6.02	2.69	1.15	7.05	4.95	6.36	1.40	10.54	3.96	8.83
CL# 3(b).10	3.11	5.61	5.98	2.66	1.14	6.95	4.83	6.41	1.48	10.40	3.96	9.34
CL# 3(b).11	3.14	5.67	6.08	2.76	1.11	7.55	4.33	7.35	1.33	11.82	4.11	7.71
CL# 3(b).12	3.03	5.52	6.02	2.70	1.15	6.98	4.85	6.17	1.42	10.34	4.17	8.38
CL# 3(b).13	3.10	5.73	6.01	2.71	1.17	7.00	4.67	6.51	1.49	11.19	4.06	8.76
CL# 3(b).14	2.98	5.65	5.90	2.89	1.11	7.76	4.28	7.51	1.37	11.57	4.08	7.62
CL# 3(b).15	3.06	5.74	5.68	2.73	1.06	7.41	4.19	7.35	1.29	11.61	4.25	7.99
CL# 3(b).16	3.00	5.74	5.62	2.84	1.08	7.27	4.26	6.83	1.37	11.64	4.37	8.37
CL# 3(b).17	3.12	5.59	6.00	2.66	1.17	6.91	5.00	5.93	1.54	9.91	4.14	8.73
CL# 3(b).18	3.01	5.65	6.06	2.69	1.15	6.96	4.93	6.48	1.53	10.92	3.97	8.66
CL# 3(b).19	3.10	5.65	5.92	2.73	1.17	6.85	4.75	6.14	1.50	10.96	3.89	8.62
CL# 3(b).20	2.99	5.75	5.72	2.82	1.23	8.06	4.50	6.83	1.41	11.64	4.24	8.33
Average	3.06	5.66	5.90	2.75	1.15	7.15	4.75	6.46	1.49	10.69	4.17	8.58
St. Deviation	0.10	0.09	0.15	0.18	0.05	0.42	0.32	0.62	0.14	0.96	0.23	0.54
2 Σ of Mean	0.05	0.04	0.07	0.08	0.02	0.19	0.14	0.28	0.06	0.43	0.10	0.24
% St. Deviation	3.33	1.52	2.57	6.67	3.97	5.94	6.68	9.67	9.28	8.94	5.59	6.31

APPENDIX B.2.7:

Trace element concentrations obtained from ICP-MS analysis of individual apatite phenocrysts from within the Sprout Brook K-bentonite layer CL# 3(c) from Cobleskill, New York. Since individual crystal weights could not be measured, values shown have no units. Average, standard deviation, 2 sigma standard error of the mean, and percent standard deviation values are shown below each analyte used in further analyses.

Sample Name	P	Ca	Ca/P*	Sr	Y	La	Ce	Pr	Nd	Sm	Eu
CL# 3(c).01	9904.08	19939.50	0.95	8.34	118.76	30.58	93.38	16.66	98.44	35.97	1.61
CL# 3(c).02	5741.94	11222.67	0.92	5.01	66.62	17.14	53.00	9.47	54.32	20.58	1.06
CL# 3(c).03	8311.52	16230.57	0.92	7.55	98.36	25.27	78.79	14.19	83.21	30.27	1.55
CL# 3(c).04	5087.51	9643.45	0.90	5.39	40.02	17.31	53.33	9.47	54.15	19.48	1.19
CL# 3(c).05	3097.09	6095.66	0.93	2.80	47.16	8.83	27.35	4.96	29.62	10.92	0.54
CL# 3(c).06	10028.65	19630.94	0.93	8.33	131.60	28.92	90.79	16.25	94.90	36.10	1.76
CL# 3(c).07	6150.01	11894.15	0.91	5.55	76.05	19.12	59.85	10.73	60.53	23.06	1.16
CL# 3(c).08	8587.85	16794.85	0.92	9.11	69.48	29.63	90.38	15.98	91.69	33.63	1.81
CL# 3(c).09	6071.19	11797.33	0.92	5.33	74.36	19.24	59.69	10.69	62.37	22.79	1.20
CL# 3(c).10	4194.49	8073.39	0.91	3.84	52.16	13.40	41.13	7.35	45.34	16.83	1.01
CL# 3(c).11	12761.65	25817.87	0.96	11.68	155.71	42.97	124.43	22.07	133.20	46.97	2.28
CL# 3(c).12	11457.74	22976.62	0.95	12.21	97.77	40.05	119.75	20.95	125.75	42.36	2.22
CL# 3(c).13	11091.10	22283.11	0.95	11.15	86.37	37.10	109.85	19.48	118.00	38.89	1.85
CL# 3(c).14	4816.91	9724.79	0.95	3.61	48.52	18.58	48.85	8.46	52.12	12.74	0.74
CL# 3(c).15	5988.24	11918.30	0.94	5.41	72.16	18.11	55.63	9.96	59.88	21.80	1.28
CL# 3(c).16	9689.76	19725.00	0.96	10.03	121.64	29.38	89.90	16.07	97.04	34.96	2.04
CL# 3(c).17	6391.59	13037.29	0.96	7.01	50.69	23.21	68.14	12.36	76.19	24.95	1.40
CL# 3(c).18	9754.19	19157.73	0.93	8.78	118.53	30.05	91.84	16.02	94.37	34.10	1.67
CL# 3(c).19	5599.63	11553.73	0.98	5.28	65.44	18.05	53.45	9.68	59.06	20.85	0.90
		Average		7.18	83.76	24.58	74.19	13.20	78.43	27.75	1.44
		St. Deviation		2.81	32.87	9.22	27.28	4.79	28.79	10.17	0.49
		2 Σ of Mean		1.29	15.08	4.23	12.52	2.20	13.21	4.67	0.22
		% St. Deviation		39.17	39.25	37.51	36.77	36.27	36.71	36.65	34.05

APPENDIX B.2.7 continued

Sample Name	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Pb	Th	U
CL# 3(c).01	42.14	6.21	29.36	4.72	6.96	0.65	2.57	0.28	7.86	3.07	1.06
CL# 3(c).02	23.85	3.47	16.15	2.65	3.70	0.37	1.46	0.15	-1.78	1.87	0.83
CL# 3(c).03	34.75	5.22	24.10	3.80	5.49	0.53	2.03	0.21	-2.40	2.84	0.98
CL# 3(c).04	21.48	2.77	11.61	1.57	2.04	0.17	0.67	0.09	7.52	2.25	0.66
CL# 3(c).05	12.95	2.01	10.37	1.81	3.06	0.31	1.28	0.15	-0.93	1.31	0.32
CL# 3(c).06	43.07	6.43	31.26	5.20	7.92	0.80	3.23	0.35	-1.90	3.54	1.23
CL# 3(c).07	26.97	3.93	17.80	2.75	4.08	0.37	1.48	0.15	-2.16	5.88	0.94
CL# 3(c).08	36.03	4.76	19.21	2.64	3.42	0.29	1.14	0.15	-2.22	2.69	0.99
CL# 3(c).09	26.43	3.94	18.19	2.90	4.01	0.40	1.52	0.17	-2.44	2.80	0.73
CL# 3(c).10	19.32	2.75	12.98	2.02	2.99	0.28	1.10	0.12	-2.26	3.40	0.76
CL# 3(c).11	55.75	8.09	38.72	6.08	9.13	0.86	3.51	0.38	0.00	3.65	1.42
CL# 3(c).12	46.93	6.41	27.60	3.97	5.51	0.48	2.00	0.23	0.00	3.23	1.34
CL# 3(c).13	42.64	6.10	25.05	3.35	4.34	0.36	1.53	0.18	0.00	3.19	1.06
CL# 3(c).14	13.38	1.82	10.11	2.13	4.39	0.56	2.75	0.35	0.00	1.56	0.47
CL# 3(c).15	25.24	3.74	18.01	2.86	4.41	0.42	1.69	0.19	0.00	2.90	0.79
CL# 3(c).16	40.91	6.12	29.33	4.72	7.02	0.67	2.74	0.32	0.00	4.29	1.34
CL# 3(c).17	27.33	3.68	15.14	2.01	2.62	0.22	0.93	0.12	0.00	3.94	0.80
CL# 3(c).18	40.68	5.98	29.55	4.70	6.97	0.67	2.67	0.30	0.00	1.32	0.81
CL# 3(c).19	24.62	3.51	17.04	2.62	3.89	0.36	1.48	0.16	0.00	3.48	0.59
Average	31.81	4.58	21.14	3.29	4.84	0.46	1.88	0.21	-0.04	3.01	0.90
St. Deviation	11.85	1.74	8.13	1.29	1.94	0.20	0.81	0.09	2.91	1.10	0.30
2 Σ of Mean	5.44	0.80	3.73	0.59	0.89	0.09	0.37	0.04	1.34	0.51	0.14
% St. Deviation	37.26	38.00	38.45	39.18	40.18	42.40	42.95	42.33	-7855.75	36.57	32.97

APPENDIX B.2.8:

Percent relative standard deviation values for each element analyzed during ICP-MS analysis of individual apatite phenocrysts from within Sprout Brook K-bentonite layer CL# 3(c) from Cobleskill, New York. These percent values are generated during 5 replicate analyses of each individual crystal analyzed.

Sample Name	P	Ca	Sr	Y	La	Ce	Pr	Nd	Sm
CL# 3(c).01	1.95	1.98	1.75	1.96	2.16	1.44	0.78	2.69	0.65
CL# 3(c).02	1.89	1.07	2.31	3.00	0.96	1.95	3.31	5.76	1.81
CL# 3(c).03	2.59	1.25	1.96	2.11	1.12	1.86	3.25	2.44	1.62
CL# 3(c).04	3.24	3.38	1.66	4.39	1.17	2.45	2.02	3.52	1.29
CL# 3(c).05	2.78	2.02	2.13	1.53	1.40	2.25	2.82	3.51	4.82
CL# 3(c).06	2.18	3.38	2.03	2.84	2.21	2.58	1.55	2.88	3.57
CL# 3(c).07	1.48	1.64	1.98	2.14	2.57	3.40	2.14	3.21	3.26
CL# 3(c).08	4.12	2.59	4.34	2.27	1.66	1.57	2.10	2.01	3.70
CL# 3(c).09	1.37	0.98	2.20	1.19	3.19	4.35	1.39	3.48	2.42
CL# 3(c).10	1.87	4.66	1.74	2.90	1.58	0.93	2.34	3.38	1.42
CL# 3(c).11	1.46	2.22	2.27	4.06	14.48	2.48	1.22	2.08	1.52
CL# 3(c).12	2.20	2.35	1.48	2.84	2.78	4.07	3.82	2.75	1.72
CL# 3(c).13	0.80	1.41	3.11	2.86	7.15	7.85	8.53	9.04	9.40
CL# 3(c).14	3.26	2.86	3.44	2.05	1.44	3.61	2.44	3.77	3.96
CL# 3(c).15	2.78	2.95	2.03	2.74	2.15	3.44	3.86	3.79	2.36
CL# 3(c).16	1.41	3.65	2.02	4.10	0.96	1.54	3.71	5.30	3.89
CL# 3(c).17	1.53	2.74	1.73	3.59	2.30	1.17	1.68	2.22	1.89
CL# 3(c).18	2.11	3.08	1.57	2.05	2.12	2.91	1.59	5.71	2.48
CL# 3(c).19	3.50	3.53	1.94	0.42	1.48	1.50	1.57	2.60	1.84

Sample Name	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Pb	Th	U
CL# 3(c).01	1.11	2.06	2.44	3.64	4.23	2.56	6.03	8.41	5.26	3.21	3.68	3.83
CL# 3(c).02	3.19	2.25	2.36	2.84	3.12	3.07	2.65	10.17	5.56	1.87	5.37	4.00
CL# 3(c).03	4.04	1.70'	1.19	0.63	3.10	4.02	3.11	6.00	2.84	0.90	1.60	6.02
CL# 3(c).04	3.34	2.55	1.78	3.37	2.37	8.57	6.17	11.14	7.23	3.11	2.97	5.50
CL# 3(c).05	6.29	3.80	1.83	2.94	2.27	5.87	2.92	7.17	3.68	7.25	4.90	4.43
CL# 3(c).06	1.24	4.96	2.22	3.87	2.81	5.58	1.93	5.69	1.17	2.18	0.90	4.00
CL# 3(c).07	3.55	1.11	2.14	3.16	4.21	3.32	4.89	3.12	8.10	2.26	8.63	20.49
CL# 3(c).08	3.66	4.11	3.20	2.21	2.89	5.20	2.56	8.42	3.34	2.39	3.50	3.14
CL# 3(c).09	4.27	2.37	3.10	1.39	2.97	2.40	4.08	2.46	7.62	2.55	2.48	4.60
CL# 3(c).10	2.24	3.89	3.11	4.59	1.60	3.48	4.85	5.21	10.58	2.48	2.71	9.58
CL# 3(c).11	3.17	2.53	2.08	2.13	3.05	1.74	2.58	4.19	2.64	9.37	7.23	2.79
CL# 3(c).12	3.55	4.25	2.31	0.87	2.69	2.90	3.24	4.26	6.69	7.09	6.12	5.02
CL# 3(c).13	8.99	8.16	1.90	2.79	2.87	3.51	8.34	3.64	6.92	122.15	7.73	4.17
CL# 3(c).14	1.66	2.49	3.09	3.65	3.46	4.31	6.00	4.61	4.70	2.28	6.89	4.06
CL# 3(c).15	8.76	2.91	3.61	3.65	3.42	4.99	5.51	3.62	4.97	175.14	5.84	4.55
CL# 3(c).16	3.17	3.52	3.05	3.76	2.87	4.82	2.36	4.01	4.08	1.29	6.81	3.52
CL# 3(c).17	2.89	2.73	3.17	3.15	2.69	4.64	4.90	4.10	7.94	18.07	8.52	2.79
CL# 3(c).18	2.67	2.22	2.93	3.93	2.56	1.90	3.83	4.20	3.56	19.90	6.72	3.51
CL# 3(c).19	4.97	1.83	2.67	4.77	5.88	4.12	5.32	6.57	2.16	0.67	92.84	24.93

APPENDIX B.2.9:

Rare earth element ratios derived from trace element concentration values found in Appendix B.2.7. for individual apatite phenocrysts from the Sprout Brook K-bentonite layer CL# 3(c) from Locality A near Cobleskill, New York. Mean, standard deviation, 2 Sigma standard error of the mean, and percent standard deviation values for trace elements are below each ratio.

Sample Name	Ce/La	Ce/Pr	Nd/Pr	Nd/Sm	Gd/Sm	Gd/Tb	Dy/Tb	Dy/Ho	Er/Ho	Er/Tm	Yb/Tm	Yb/Lu
CL# 3(c).01	3.05	5.60	5.91	2.74	1.17	6.78	4.72	6.22	1.48	10.63	3.92	9.08
CL# 3(c).02	3.09	5.60	5.74	2.64	1.16	6.86	4.65	6.10	1.40	10.13	3.99	9.87
CL# 3(c).03	3.12	5.55	5.86	2.75	1.15	6.66	4.62	6.34	1.44	10.31	3.81	9.50
CL# 3(c).04	3.08	5.63	5.72	2.78	1.10	7.75	4.19	7.41	1.30	12.34	4.04	7.83
CL# 3(c).05	3.10	5.51	5.97	2.71	1.19	6.45	5.17	5.72	1.69	9.97	4.18	8.66
CL# 3(c).06	3.14	5.59	5.84	2.63	1.19	6.70	4.86	6.01	1.52	9.84	4.01	9.21
CL# 3(c).07	3.13	5.58	5.64	2.63	1.17	6.86	4.53	6.47	1.48	10.95	3.97	9.66
CL# 3(c).08	3.05	5.66	5.74	2.73	1.07	7.57	4.04	7.28	1.30	11.69	3.90	7.65
CL# 3(c).09	3.10	5.59	5.84	2.74	1.16	6.70	4.61	6.27	1.38	10.08	3.83	8.71
CL# 3(c).10	3.07	5.59	6.17	2.69	1.15	7.02	4.72	6.44	1.48	10.66	3.93	9.30
CL# 3(c).11	2.90	5.64	6.04	2.84	1.19	6.89	4.78	6.37	1.50	10.60	4.08	9.15
CL# 3(c).12	2.99	5.72	6.00	2.97	1.11	7.32	4.30	6.95	1.39	11.58	4.22	8.66
CL# 3(c).13	2.96	5.64	6.06	3.03	1.10	6.99	4.11	7.47	1.29	11.94	4.22	8.41
CL# 3(c).14	2.63	5.78	6.16	4.09	1.05	7.34	5.55	4.75	2.06	7.84	4.92	7.88
CL# 3(c).15	3.07	5.59	6.01	2.75	1.16	6.75	4.82	6.30	1.54	10.48	4.03	8.87
CL# 3(c).16	3.06	5.59	6.04	2.78	1.17	6.68	4.79	6.21	1.49	10.41	4.06	8.67
CL# 3(c).17	2.94	5.51	6.17	3.05	1.10	7.43	4.11	7.53	1.30	11.83	4.18	7.96
CL# 3(c).18	3.06	5.73	5.89	2.77	1.19	6.80	4.94	6.29	1.48	10.41	3.99	8.99
CL# 3(c).19	2.96	5.52	6.10	2.83	1.18	7.02	4.86	6.50	1.48	10.73	4.09	9.45
Average	3.03	5.61	5.94	2.85	1.14	6.98	4.65	6.45	1.47	10.65	4.07	8.81
St. Deviation	0.12	0.07	0.16	0.32	0.04	0.35	0.38	0.67	0.17	1.00	0.24	0.64
2 Σ of Mean	0.05	0.03	0.07	0.15	0.02	0.16	0.18	0.31	0.08	0.46	0.11	0.30
% St. Deviation	3.90	1.28	2.72	11.38	3.82	4.99	8.22	10.34	11.80	9.35	5.83	7.31

APPENDIX B.2.10:

Trace element concentrations obtained from ICP-MS analysis of individual apatite phenocrysts from within the Sprout Brook K-bentonite layer CL# 3(d) from Cobleskill, New York. Since individual crystal weights could not be measured, values shown have no units. Average, standard deviation, 2 sigma standard error of the mean, and percent standard deviation values are shown below each analyte used in further analyses.

Sample Name	P	Ca	Ca/P*	Sr	Y	La	Ce	Pr	Nd	Sm	Eu
CL# 3(d).01	3773.83	7584.95	0.95	3.97	43.74	11.12	33.42	5.96	35.73	12.81	0.80
CL# 3(d).02	9733.39	19167.04	0.93	8.92	117.91	29.47	90.91	16.18	97.15	34.42	1.69
CL# 3(d).03	9318.05	18372.72	0.93	8.50	105.85	28.56	87.25	15.69	93.16	33.42	1.59
CL# 3(d).04	5278.60	10669.69	0.96	5.19	66.56	16.08	49.99	8.86	53.94	19.48	1.13
CL# 3(d).05	8552.73	16867.42	0.93	8.37	103.07	25.72	80.85	14.11	85.12	30.57	1.76
CL# 3(d).06	7437.05	14688.08	0.93	6.71	90.56	21.87	68.58	12.02	70.35	26.33	1.31
CL# 3(d).07	8755.59	17320.79	0.94	7.88	107.60	26.61	79.74	14.11	85.20	30.63	1.48
CL# 3(d).08	3144.59	5964.85	0.90	3.21	36.76	9.24	30.10	5.14	30.83	11.68	0.74
CL# 3(d).09	5359.85	10931.03	0.96	5.67	62.80	16.90	51.46	8.98	52.80	19.36	1.06
CL# 3(d).10	19062.90	38553.46	0.96	17.22	215.48	58.08	177.49	30.94	183.08	65.67	3.17
CL# 3(d).11	10309.93	21095.63	0.97	11.06	87.03	35.65	106.09	18.42	109.55	36.21	2.10
CL# 3(d).12	4598.78	9355.41	0.96	4.74	51.71	13.97	44.19	7.68	44.69	16.42	1.01
CL# 3(d).13	3054.32	5946.57	0.92	2.98	35.58	9.82	30.45	5.23	30.90	11.07	0.60
CL# 3(d).14	7355.68	14601.59	0.94	9.24	52.91	26.49	79.44	13.68	77.56	26.34	1.48
CL# 3(d).15	5792.43	11730.96	0.96	6.13	69.04	18.64	57.08	10.16	60.14	22.35	1.41
CL# 3(d).16	6308.20	12751.02	0.96	5.96	77.90	20.07	61.00	10.72	62.93	23.05	1.19
CL# 3(d).17	5108.71	9819.51	0.91	4.89	60.14	16.13	49.65	8.43	47.66	18.27	0.91
		Average		7.10	81.45	22.61	69.27	12.14	71.81	25.77	1.38
		St. Deviation		3.45	42.99	11.83	35.75	6.26	37.22	13.01	0.61
		2 Σ of Mean		1.67	20.85	5.74	17.34	3.04	18.05	6.31	0.30
		% St. Deviation		48.62	52.78	52.33	51.61	51.58	51.83	50.48	44.19

Sample Name	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Pb	Th	U
CL# 3(d).01	15.34	2.30	11.15	1.76	2.59	0.25	1.03	0.11	13.06	1.61	0.38
CL# 3(d).02	41.11	6.12	29.51	4.65	6.77	0.63	2.53	0.28	-2.46	5.36	1.15
CL# 3(d).03	40.07	5.81	27.22	4.30	6.28	0.58	2.23	0.25	-1.77	3.21	1.00
CL# 3(d).04	23.05	3.33	16.18	2.63	3.75	0.37	1.48	0.16	-2.20	1.09	0.59
CL# 3(d).05	36.98	5.42	25.96	4.06	6.04	0.58	2.39	0.26	-1.46	1.64	0.99
CL# 3(d).06	32.37	4.69	22.98	3.64	5.37	0.50	2.07	0.21	-2.41	2.80	0.77
CL# 3(d).07	37.25	5.41	26.14	4.19	6.07	0.58	2.38	0.25	-1.75	2.91	0.91
CL# 3(d).08	13.82	1.97	9.49	1.46	2.07	0.19	0.75	0.09	-2.49	2.24	0.41
CL# 3(d).09	22.56	3.36	16.90	2.63	3.83	0.36	1.54	0.16	0.00	2.55	0.61
CL# 3(d).10	76.92	11.54	56.46	8.91	13.10	1.23	8.98	0.56	0.00	3.61	1.75
CL# 3(d).11	39.66	5.53	24.64	3.59	5.23	0.48	2.08	0.24	0.00	3.87	0.99
CL# 3(d).12	19.31	2.86	13.80	2.13	3.24	0.31	1.30	0.14	0.00	1.04	0.46
CL# 3(d).13	12.87	1.94	9.30	1.44	2.10	0.20	0.80	0.09	0.00	0.48	0.34
CL# 3(d).14	28.64	3.93	16.28	2.14	2.89	0.24	1.08	0.13	0.00	3.87	1.08
CL# 3(d).15	26.03	3.77	17.94	2.78	4.01	0.37	1.71	0.18	0.00	3.74	0.79
CL# 3(d).16	27.23	4.07	19.83	3.18	4.70	0.46	1.83	0.21	0.00	1.19	0.63
CL# 3(d).17	21.56	3.19	15.72	2.42	3.57	0.33	1.32	0.15	0.00	1.09	0.48
Average	30.28	4.42	21.15	3.29	4.80	0.45	2.09	0.20	-0.09	2.49	0.78
St. Deviation	15.23	2.27	11.06	1.76	2.61	0.25	1.86	0.11	3.55	1.34	0.36
2 Σ of Mean	7.39	1.10	5.36	0.86	1.26	0.12	0.90	0.05	1.72	0.65	0.18
% St. Deviation	50.28	51.35	52.28	53.65	54.29	54.56	89.28	53.55	-4083.88	54.01	46.10

APPENDIX B.2.11:

Percent relative standard deviation values for each element analyzed during ICP-MS analysis of individual apatite phenocrysts from within Sprout Brook K-bentonite layer CL# 3(d) from Cobleskill, New York. These percent values are generated during 5 replicate analyses of each individual crystal analyzed.

Sample Name	P	Ca	Sr	Y	La	Ce	Pr	Nd	Sm
CL# 3(d).01	2.04	1.69	2.64	2.00	1.24	1.71	1.42	3.55	3.39
CL# 3(d).02	3.66	4.03	1.29	2.90	1.78	1.29	2.20	2.44	0.98
CL# 3(d).03	1.13	0.96	2.06	2.32	1.95	1.07	1.23	4.44	2.66
CL# 3(d).04	2.86	3.76	2.26	3.59	2.87	4.11	3.01	5.36	2.06
CL# 3(d).05	3.15	2.96	3.23	2.63	1.18	1.94	2.05	2.84	2.23
CL# 3(d).06	2.42	2.31	1.83	1.73	2.58	1.37	2.03	4.65	4.56
CL# 3(d).07	2.71	3.16	1.04	2.40	2.01	2.51	2.97	3.69	3.13
CL# 3(d).08	2.83	1.16	1.97	4.71	2.45	1.97	1.78	8.55	1.79
CL# 3(d).09	3.04	3.93	1.92	2.30	2.10	2.28	1.85	2.91	0.79
CL# 3(d).10	3.22	1.20	1.78	2.70	2.29	2.99	2.00	3.34	1.80
CL# 3(d).11	2.22	3.50	2.35	1.59	3.40	2.29	1.96	2.00	1.87
CL# 3(d).12	2.88	5.42	1.96	3.49	1.42	1.65	2.47	4.85	2.33
CL# 3(d).13	3.20	1.94	1.30	3.33	3.26	1.13	1.84	6.80	3.45
CL# 3(d).14	1.60	3.89	1.60	1.77	2.30	2.33	2.93	2.42	3.86
CL# 3(d).15	3.48	4.17	2.31	2.85	1.61	2.66	1.40	3.33	2.39
CL# 3(d).16	4.23	5.01	2.90	2.86	1.70	1.13	1.28	1.55	2.15
CL# 3(d).17	1.74	3.06	3.32	1.94	1.93	1.73	1.49	6.80	2.39

Sample Name	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Pb	Th	U
CL# 3(d).01	5.28	1.34	1.60	1.60	3.69	5.73	7.04	7.22	7.92	0.73	3.64	2.84
CL# 3(d).02	2.31	1.63	1.98	1.95	2.37	6.14	6.80	5.15	3.33	2.26	4.04	7.36
CL# 3(d).03	3.98	1.22	2.80	1.51	2.71	3.77	4.29	4.92	7.97	2.73	1.85	3.88
CL# 3(d).04	0.46	3.36	1.91	2.59	1.48	2.69	4.85	4.30	6.86	2.05	2.56	4.33
CL# 3(d).05	1.19	1.39	3.29	1.58	1.51	2.43	2.55	3.72	3.65	6.89	2.38	3.64
CL# 3(d).06	3.87	3.37	2.53	4.84	3.14	3.94	3.40	7.21	7.73	1.84	1.87	3.97
CL# 3(d).07	2.99	1.73	1.43	1.84	1.76	3.49	3.67	3.37	3.39	4.10	3.57	0.62
CL# 3(d).08	1.91	3.02	2.77	3.64	1.61	4.06	7.49	6.15	7.19	3.25	1.92	5.84
CL# 3(d).09	3.00	3.91	2.80	2.10	2.03	1.82	1.47	3.15	2.29	2.82	4.36	2.06
CL# 3(d).10	2.61	2.12	3.34	3.39	2.75	2.30	3.82	98.16	4.00	3.72	5.95	5.57
CL# 3(d).11	3.26	2.81	1.91	3.50	2.45	4.45	2.05	5.61	3.09	16.37	3.11	2.01
CL# 3(d).12	1.73	1.60	0.56	2.53	1.61	8.49	1.67	6.80	2.83	1.74	7.10	4.04
CL# 3(d).13	5.46	1.97	3.30	2.69	1.76	4.77	2.40	5.19	6.60	7.99	7.45	3.97
CL# 3(d).14	2.22	1.83	0.79	2.07	2.15	3.69	5.27	5.40	8.47	3.39	7.32	4.08
CL# 3(d).15	2.27	3.37	2.46	3.11	3.37	6.62	3.86	28.41	4.99	25.07	4.60	3.38
CL# 3(d).16	4.34	3.31	2.25	2.53	4.26	3.38	4.29	4.62	3.13	15.78	7.29	2.99
CL# 3(d).17	1.96	2.19	1.91	2.09	1.80	5.22	5.88	5.32	3.77	22.08	5.93	5.11

APPENDIX B.2.12:

Rare earth element ratios derived from trace element concentration values found in Appendix B.2.10. for individual apatite phenocrysts from the Sprout Brook K-bentonite layer CL# 3(d) from Locality A near Cobleskill, New York. Mean, standard deviation, 2 Sigma standard error of the mean, and percent standard deviation values for trace elements are below each ratio.

Sample Name	Ce/La	Ce/Pr	Nd/Pr	Nd/Sm	Gd/Sm	Gd/Tb	Dy/Tb	Dy/Ho	Er/Ho	Er/Tm	Yb/Tm	Yb/Lu
CL# 3(d).01	3.00	5.60	5.99	2.79	1.20	6.67	4.85	6.35	1.47	10.48	4.18	9.74
CL# 3(d).02	3.08	5.62	6.00	2.82	1.19	6.72	4.82	6.35	1.46	10.69	3.99	9.16
CL# 3(d).03	3.06	5.56	5.94	2.79	1.20	6.90	4.69	6.34	1.46	10.92	3.87	8.95
CL# 3(d).04	3.11	5.64	6.09	2.77	1.18	6.92	4.85	6.14	1.42	10.10	3.99	9.22
CL# 3(d).05	3.14	5.73	6.03	2.78	1.21	6.82	4.79	6.40	1.49	10.37	4.09	9.27
CL# 3(d).06	3.14	5.71	5.85	2.67	1.23	6.91	4.90	6.32	1.48	10.72	4.13	9.63
CL# 3(d).07	3.00	5.65	6.04	2.78	1.22	6.88	4.83	6.25	1.45	10.53	4.13	9.45
CL# 3(d).08	3.26	5.85	5.99	2.64	1.18	7.03	4.83	6.51	1.42	10.67	3.87	8.32
CL# 3(d).09	3.04	5.73	5.88	2.73	1.17	6.72	5.03	6.42	1.45	10.54	4.24	9.49
CL# 3(d).10	3.06	5.74	5.92	2.79	1.17	6.66	4.89	6.33	1.47	10.65	7.30	16.10
CL# 3(d).11	2.98	5.76	5.95	3.03	1.10	7.17	4.45	6.86	1.46	10.88	4.32	8.64
CL# 3(d).12	3.16	5.76	5.82	2.72	1.18	6.74	4.82	6.48	1.52	10.57	4.25	9.44
CL# 3(d).13	3.10	5.82	5.90	2.79	1.16	6.64	4.79	6.47	1.46	10.58	4.01	8.83
CL# 3(d).14	3.00	5.81	5.67	2.94	1.09	7.30	4.15	7.61	1.35	12.10	4.53	8.14
CL# 3(d).15	3.06	5.62	5.92	2.69	1.16	6.91	4.76	6.44	1.44	10.83	4.63	9.51
CL# 3(d).16	3.04	5.69	5.87	2.73	1.18	6.69	4.88	6.24	1.48	10.32	4.02	8.78
CL# 3(d).17	3.08	5.89	5.65	2.61	1.18	6.77	4.93	6.50	1.48	10.79	4.00	8.72
AVERAGE	3.08	5.72	5.91	2.77	1.18	6.85	4.78	6.47	1.46	10.69	4.33	9.49
St. Deviation	0.07	0.09	0.12	0.10	0.04	0.18	0.20	0.33	0.04	0.42	0.79	1.76
2 Σ of Mean	0.03	0.05	0.06	0.05	0.02	0.09	0.10	0.16	0.02	0.20	0.39	0.86
% St. Deviation	2.31	1.62	2.00	3.67	3.14	2.68	4.24	5.13	2.48	3.92	18.35	18.58

APPENDIX B.2.13:

Trace element concentrations obtained from ICP-MS analysis of individual apatite phenocrysts from within the Sprout Brook K-bentonite layer CL# 3(e) from Cobleskill, New York. Since individual crystal weights could not be measured, values shown have no units. Average, standard deviation, 2 sigma standard error of the mean, and percent standard deviation values are shown below each analyte used in further analyses

Sample Name	P	Ca	Ca/P	Sr	Y	La	Ce	Pr	Nd	Sm	Eu
CL# 3(e).01	4651.94	9278.46	0.94	4.28	56.09	14.48	44.06	7.86	47.15	16.87	0.98
CL# 3(e).02	15037.90	29578.92	0.93	13.48	212.19	44.65	136.28	23.97	142.75	52.69	2.84
CL# 3(e).03	10144.28	19940.15	0.93	8.78	121.45	31.75	94.78	16.86	100.29	36.69	1.73
CL# 3(e).04	33232.48	65725.94	0.94	28.86	385.48	100.19	304.73	54.07	313.20	115.42	5.12
CL# 3(e).05	7008.57	13976.22	0.94	6.50	84.65	21.50	66.21	11.80	67.40	25.43	1.40
CL# 3(e).06	8859.20	17623.50	0.94	8.13	107.82	26.43	82.10	14.33	86.93	31.68	1.75
CL# 3(e).07	14219.80	27989.30	0.93	12.58	166.22	44.37	137.03	24.67	148.08	52.40	2.61
CL# 3(e).08	5436.49	10668.20	0.93	5.57	69.87	16.21	50.45	8.95	51.87	19.39	1.43
CL# 3(e).09	18728.13	36674.52	0.93	17.79	229.87	58.50	177.72	31.97	186.68	67.87	3.67
CL# 3(e).10	15973.93	31292.75	0.93	14.71	191.05	49.65	152.79	27.11	161.18	58.35	2.98
CL# 3(e).11	8371.77	16662.71	0.94	7.45	97.97	25.73	77.64	13.53	78.53	28.85	1.22
CL# 3(e).12	11317.98	22818.98	0.95	10.40	128.20	33.95	103.88	18.12	103.76	38.04	1.80
CL# 3(e).13	3113.46	6332.08	0.96	2.84	39.58	10.04	31.02	5.32	30.09	10.97	0.52
CL# 3(e).14	6933.87	14550.97	0.99	15.12	87.69	23.13	71.28	12.58	71.63	26.57	1.43
CL# 3(e).15	4226.17	8551.88	0.96	3.81	48.34	13.28	39.99	6.99	40.03	14.57	0.73
CL# 3(e).16	5722.71	11298.23	0.93	5.29	69.59	18.01	56.12	9.63	55.51	20.80	1.11
CL# 3(e).17	2067.70	4005.71	0.92	2.18	25.63	6.68	21.33	3.67	21.19	7.92	0.53
CL# 3(e).18	13029.03	26010.83	0.94	12.10	155.77	41.28	126.65	22.04	129.96	47.29	2.48
CL# 3(e).19	11098.92	21655.83	0.92	9.78	126.91	33.89	104.60	18.30	102.34	38.85	1.86
CL# 3(e).20	8054.16	16077.54	0.94	7.28	92.65	25.58	76.49	13.53	80.26	28.36	1.42
		Average		9.85	124.85	31.96	97.76	17.26	100.94	36.95	1.88
		St. Deviation		6.26	83.50	21.27	64.69	11.54	67.44	24.68	1.13
		2 Σ of Mean		2.80	37.34	9.51	28.93	5.16	30.16	11.04	0.51
		% St. Deviation		63.56	66.88	66.55	66.17	66.83	66.81	66.78	60.27

APPENDIX B.2.13 continued

Sample Name	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Pb	Th	U
CL# 3(e).01	20.09	3.00	14.14	2.20	3.34	0.29	1.19	0.14	-2.48	0.58	0.49
CL# 3(e).02	64.03	9.83	51.00	8.79	14.30	1.50	6.37	0.68	-2.07	1.26	1.75
CL# 3(e).03	43.71	6.36	30.82	4.77	7.15	0.65	2.55	0.28	-2.64	0.73	0.94
CL# 3(e).04	137.17	20.39	100.19	15.56	22.98	2.14	8.32	0.93	0.13	2.62	2.85
CL# 3(e).05	30.39	4.41	21.20	3.30	4.89	0.47	1.88	0.20	-2.36	0.57	0.71
CL# 3(e).06	37.88	5.47	27.23	4.33	6.52	0.63	2.66	0.29	-1.75	1.29	0.88
CL# 3(e).07	62.97	9.05	42.91	6.48	9.33	0.84	3.29	0.37	-2.11	1.13	1.53
CL# 3(e).08	23.04	3.45	17.17	2.81	4.26	0.42	1.64	0.18	3.37	0.92	0.57
CL# 3(e).09	82.15	12.02	58.85	9.36	13.88	1.30	5.17	0.57	-1.30	2.14	2.44
CL# 3(e).10	69.43	9.99	49.34	7.57	11.20	1.04	4.17	0.46	-2.04	1.52	1.60
CL# 3(e).11	33.08	5.00	24.75	3.88	5.61	0.53	2.18	0.24	0.00	0.83	0.68
CL# 3(e).12	44.02	6.81	33.86	5.39	8.02	0.78	3.14	0.35	0.00	0.99	0.97
CL# 3(e).13	12.77	1.94	9.68	1.54	2.34	0.22	0.91	0.10	0.00	0.36	0.32
CL# 3(e).14	30.71	4.71	23.12	3.59	5.21	0.48	1.95	0.22	0.00	0.70	0.84
CL# 3(e).15	16.60	2.50	12.34	1.94	2.80	0.27	1.11	0.12	0.00	0.45	0.41
CL# 3(e).16	23.83	3.61	17.82	2.80	4.11	0.38	1.61	0.18	0.00	0.49	0.65
CL# 3(e).17	9.17	1.34	6.66	1.03	1.57	0.14	0.58	0.06	0.00	0.33	0.23
CL# 3(e).18	54.15	8.24	39.99	6.22	9.01	0.86	3.51	0.41	0.00	1.34	1.54
CL# 3(e).19	44.95	6.73	33.49	5.42	8.05	0.73	3.06	0.33	0.00	0.99	1.03
CL# 3(e).20	32.56	4.89	24.32	3.77	5.54	0.51	2.16	0.24	0.00	0.94	0.78
Average	43.63	6.49	31.94	5.04	7.50	0.71	2.87	0.32	-0.66	1.01	1.06
St. Deviation	29.61	4.37	21.54	3.39	5.08	0.49	1.93	0.21	1.43	0.58	0.70
2 Σ of Mean	13.24	1.96	9.63	1.51	2.27	0.22	0.86	0.10	0.64	0.26	0.31
% St. Deviation	67.85	67.39	67.44	67.24	67.68	68.57	67.18	67.32	-215.95	57.82	65.62

APPENDIX B.2.14:

Percent relative standard deviation values for each element analyzed during ICP-MS analysis of individual apatite phenocrysts from within Sprout Brook K-bentonite layer CL# 3(e) from Cobleskill, New York. These percent values are generated during the 16 analytical passes, each containing 5 replicate analyses, for each individual crystal analyzed.

Sample Name	P	Ca	Sr	Y	La	Ce	Pr	Nd	Sm
CL# 3(e).01	2.66	2.99	1.07	2.87	2.74	2.89	0.88	2.93	4.67
CL# 3(e).02	1.71	2.07	2.27	2.64	2.70	1.97	1.62	2.53	1.70
CL# 3(e).03	1.09	2.32	1.00	2.22	2.35	1.04	1.69	1.24	0.94
CL# 3(e).04	3.43	1.96	2.21	2.84	1.24	1.63	1.81	1.58	1.92
CL# 3(e).05	3.06	2.28	1.68	2.39	0.64	3.91	1.83	3.22	1.21
CL# 3(e).06	2.78	3.38	0.89	3.97	1.90	2.69	2.83	4.02	2.39
CL# 3(e).07	2.04	2.60	2.67	2.55	1.54	1.30	1.15	1.75	1.31
CL# 3(e).08	2.62	0.82	0.35	1.16	2.82	4.19	1.33	4.55	1.97
CL# 3(e).09	2.22	1.75	1.90	0.81	2.68	2.12	1.36	3.15	2.06
CL# 3(e).10	1.38	1.80	2.24	2.13	2.79	1.46	0.41	2.72	2.66
CL# 3(e).11	2.11	3.09	2.67	2.44	2.39	1.77	1.82	2.27	3.49
CL# 3(e).12	3.08	4.54	2.20	3.77	1.27	1.11	1.62	4.09	2.37
CL# 3(e).13	2.79	5.46	3.09	4.30	2.28	3.84	2.67	1.62	3.61
CL# 3(e).14	2.04	3.32	3.01	2.03	1.96	1.68	1.85	3.82	2.32
CL# 3(e).15	1.71	2.87	1.43	3.73	2.13	1.06	2.35	4.49	3.58
CL# 3(e).16	1.62	3.15	1.55	3.24	1.75	2.56	1.90	6.35	2.60
CL# 3(e).17	2.73	3.50	1.49	2.57	1.01	1.52	1.51	4.08	1.81
CL# 3(e).18	1.70	2.33	0.68	1.99	1.44	2.08	1.85	3.15	2.30
CL# 3(e).19	2.96	3.95	1.28	2.92	3.07	3.11	2.65	4.23	4.36
CL# 3(e).20	2.09	4.05	0.63	2.79	1.68	1.74	0.83	6.43	2.18

Sample Name	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Pb	Th	U
CL# 3(e).01	2.34	3.91	1.99	2.53	1.05	8.00	2.76	3.42	4.82	2.09	4.66	6.59
CL# 3(e).02	1.71	2.70	3.71	3.76	3.28	2.93	1.63	5.98	1.29	4.96	6.69	3.48
CL# 3(e).03	2.45	2.39	1.70	3.84	1.48	4.26	4.27	5.13	2.85	1.02	4.98	2.54
CL# 3(e).04	1.71	1.49	2.21	3.15	1.47	2.83	1.73	3.40	2.65	65.57	3.24	1.71
CL# 3(e).05	1.81	3.34	1.22	2.28	2.06	6.29	5.28	2.75	4.22	1.51	4.78	3.95
CL# 3(e).06	3.63	1.47	1.56	1.77	0.97	2.78	3.39	3.10	7.57	4.73	8.22	6.49
CL# 3(e).07	3.89	1.09	1.58	3.23	2.99	4.20	1.37	4.02	3.62	5.81	9.62	4.23
CL# 3(e).08	2.39	1.38	3.18	1.85	3.51	2.00	3.71	3.38	2.51	5.24	6.92	4.11
CL# 3(e).09	2.76	2.29	1.52	2.63	4.72	3.26	0.93	4.56	2.61	3.93	5.24	1.39
CL# 3(e).10	2.95	1.73	1.55	3.17	1.38	2.68	2.72	3.36	4.52	1.61	5.67	2.81
CL# 3(e).11	4.32	2.24	1.67	2.64	1.94	2.12	3.31	4.22	4.09	50.06	14.83	5.53
CL# 3(e).12	1.69	2.50	3.15	2.42	2.75	3.57	3.46	3.56	4.04	9.72	8.95	3.45
CL# 3(e).13	4.37	3.28	2.79	4.04	2.47	7.06	1.64	5.24	9.46	10.24	3.19	2.43
CL# 3(e).14	2.12	4.70	2.24	2.58	3.02	3.87	1.99	2.32	4.67	2.37	7.76	5.34
CL# 3(e).15	3.40	2.05	3.04	3.58	2.94	3.13	3.65	5.59	3.49	9.92	8.39	4.15
CL# 3(e).16	2.31	3.13	3.75	3.36	3.07	3.78	3.01	7.26	4.23	2.31	2.37	18.72
CL# 3(e).17	1.52	1.44	2.85	4.84	4.51	7.20	5.59	7.11	5.14	12.01	13.36	2.89
CL# 3(e).18	3.55	4.22	3.13	2.51	2.20	3.08	3.36	5.10	4.97	7.78	8.42	6.47
CL# 3(e).19	2.15	2.73	1.32	3.53	3.47	1.36	2.14	3.77	3.56	4.20	8.15	4.53
CL# 3(e).20	2.86	3.28	3.40	2.57	3.01	3.25	4.26	1.47	2.47	4.47	16.54	4.52

APPENDIX B.2.15:

`Rare earth element ratios derived from trace element concentration values found in Appendix B.2.13. for individual apatite phenocrysts from the Sprout Brook K-bentonite layer CL# 3(e) from Locality A near Cobleskill, New York. Mean, standard deviation, 2 Sigma standard error of the mean, and percent standard deviation values for trace elements are below each ratio.

Sample Name	Ce/La	Ce/Pr	Nd/Pr	Nd/Sm	Gd/Sm	Gd/Tb	Dy/Tb	Dy/Ho	Er/Ho	Er/Tm	Yb/Tm	Yb/Lu
CL# 3(e).01	3.04	5.61	6.00	2.79	1.19	6.70	4.72	6.43	1.52	11.42	4.06	8.73
CL# 3(e).02	3.05	5.69	5.96	2.71	1.22	6.51	5.19	5.80	1.63	9.54	4.25	9.30
CL# 3(e).03	2.99	5.62	5.95	2.73	1.19	6.87	4.85	6.46	1.50	10.99	3.92	8.95
CL# 3(e).04	3.04	5.64	5.79	2.71	1.19	6.73	4.91	6.44	1.48	10.75	3.89	8.93
CL# 3(e).05	3.08	5.61	5.71	2.65	1.20	6.89	4.81	6.43	1.48	10.51	4.03	9.44
CL# 3(e).06	3.11	5.73	6.07	2.74	1.20	6.92	4.98	6.29	1.51	10.35	4.22	9.20
CL# 3(e).07	3.09	5.56	6.00	2.83	1.20	6.96	4.74	6.62	1.44	11.08	3.91	9.00
CL# 3(e).08	3.11	5.63	5.79	2.67	1.19	6.68	4.98	6.12	1.52	10.23	3.93	8.93
CL# 3(e).09	3.04	5.56	5.84	2.75	1.21	6.83	4.90	6.29	1.48	10.66	3.97	9.02
CL# 3(e).10	3.08	5.64	5.95	2.76	1.19	6.95	4.94	6.52	1.48	10.80	4.03	9.12
CL# 3(e).11	3.02	5.74	5.81	2.72	1.15	6.61	4.95	6.38	1.45	10.50	4.07	9.07
CL# 3(e).12	3.06	5.73	5.73	2.73	1.16	6.46	4.97	6.28	1.49	10.29	4.03	9.01
CL# 3(e).13	3.09	5.83	5.66	2.74	1.16	6.57	4.98	6.27	1.51	10.79	4.21	9.22
CL# 3(e).14	3.08	5.66	5.69	2.70	1.16	6.51	4.90	6.43	1.45	10.82	4.05	8.95
CL# 3(e).15	3.01	5.72	5.73	2.75	1.14	6.64	4.94	6.36	1.44	10.50	4.16	9.00
CL# 3(e).16	3.12	5.83	5.77	2.67	1.15	6.60	4.94	6.37	1.47	10.75	4.22	8.89
CL# 3(e).17	3.19	5.81	5.77	2.68	1.16	6.86	4.98	6.45	1.52	11.20	4.15	9.44
CL# 3(e).18	3.07	5.75	5.90	2.75	1.15	6.57	4.85	6.43	1.45	10.50	4.09	8.66
CL# 3(e).19	3.09	5.72	5.59	2.63	1.16	6.68	4.98	6.18	1.49	10.97	4.17	9.32
CL# 3(e).20	2.99	5.65	5.93	2.83	1.15	6.66	4.97	6.45	1.47	10.85	4.22	9.09
AVERAGE	3.07	5.69	5.83	2.73	1.17	6.71	4.92	6.35	1.49	10.67	4.08	9.06
St. Deviation	0.05	0.08	0.13	0.05	0.02	0.16	0.10	0.17	0.04	0.41	0.12	0.21
2 Σ of Mean	0.02	0.04	0.06	0.02	0.01	0.07	0.04	0.08	0.02	0.18	0.05	0.09
% St. Deviation	1.58	1.45	2.24	1.93	2.09	2.33	2.04	2.72	2.81	3.80	2.85	2.31

APPENDIX B.2.16:

Trace element concentrations obtained from ICP-MS analysis of individual apatite phenocrysts from within the Sprout Brook K-bentonite layer CL# 3(A) from Cobleskill, New York. Since individual crystal weights could not be measured, values shown have no units. Average, standard deviation, 2 sigma standard error of the mean, and percent standard deviation values are shown below each analyte used in further analyses.

Sample Name	P	Ca	Ca/P*	Sr	Y	La	Ce	Pr	Nd	Sm	Eu
CL# 3A.01	3402.21	7337.58	1.02	2.96	53.13	22.54	59.62	9.82	56.87	13.92	0.62
CL# 3A.02	5116.69	10629.16	0.98	4.27	80.81	32.81	88.59	14.43	81.74	20.59	0.91
CL# 3A.03	2177.53	4673.16	1.01	1.78	35.79	14.45	38.71	6.32	36.93	9.02	0.40
CL# 3A.04	1469.59	3011.61	0.97	1.08	23.07	9.46	25.53	4.23	23.86	6.19	0.28
CL# 3A.05	2355.72	5840.68	1.17	2.55	24.19	7.86	23.73	4.16	23.62	7.48	0.37
CL# 3A.06	1471.76	2886.39	0.93	1.06	23.53	10.02	26.87	4.35	24.46	6.07	0.26
CL# 3A.07	3400.58	6940.08	0.96	2.79	53.79	22.19	59.35	9.70	55.25	13.79	0.63
CL# 3A.08	10118.41	20817.97	0.97	7.90	154.57	65.41	173.95	28.32	166.65	40.33	1.66
CL# 3A.09	2050.97	4319.02	1.00	1.54	41.07	16.31	43.15	7.20	42.57	10.46	0.44
CL# 3A.10	3078.87	6265.88	0.96	2.58	49.00	19.50	52.74	8.64	49.36	12.27	0.59
CL# 3A.11	2697.39	5657.11	0.99	2.08	41.09	17.08	45.06	7.36	42.56	10.51	0.48
CL# 3A.12	1831.71	3938.45	1.02	1.32	29.04	11.79	31.80	5.20	30.30	7.76	0.35
CL# 3A.13	851.40	1996.24	1.11	1.13	9.65	4.42	12.51	2.12	12.24	3.19	0.11
CL# 3A.14	2217.48	4674.24	1.00	1.69	34.56	14.58	39.08	6.40	35.78	9.31	0.42
CL# 3A.15	7466.16	15635.60	0.99	6.34	100.90	42.06	111.94	18.29	107.33	26.73	1.30
CL# 3A.16	1117.63	2285.22	0.97	0.59	6.48	3.00	7.85	1.25	7.19	1.67	0.11
		Average		2.60	47.54	19.59	52.53	8.61	49.79	12.46	0.56
		St. Deviation		2.01	37.47	15.83	41.98	6.82	40.11	9.69	0.42
		2 Σ of Mean		1.00	18.73	7.92	20.99	3.41	20.06	4.85	0.21
		% St. Deviation		77.09	78.81	80.81	79.91	79.19	80.56	77.83	74.48

Sample Name	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Pb	Th	U
CL# 3A.01	14.66	2.04	11.30	2.36	4.67	0.59	2.74	0.34	1.06	-61.08	0.27
CL# 3A.02	21.29	2.99	16.47	3.50	6.78	0.86	4.01	0.49	1.05	-63.36	0.29
CL# 3A.03	9.66	1.30	7.27	1.48	3.00	0.36	1.72	0.22	-0.72	1.58	0.13
CL# 3A.04	6.31	0.87	4.83	0.99	1.99	0.24	1.16	0.15	-2.17	1.42	0.09
CL# 3A.05	7.68	1.09	5.54	0.99	2.01	0.26	1.30	0.16	4.87	1.56	0.25
CL# 3A.06	6.64	0.88	4.89	1.00	2.04	0.25	1.18	0.15	-3.66	0.79	0.08
CL# 3A.07	14.51	1.99	11.02	2.30	4.60	0.56	2.71	0.33	-0.79	2.04	0.23
CL# 3A.08	42.38	5.85	32.33	6.77	13.35	1.64	7.83	0.96	0.58	5.38	0.50
CL# 3A.09	10.78	1.53	8.51	1.76	3.46	0.44	2.04	0.25	-3.57	1.95	0.20
CL# 3A.10	12.88	1.82	9.93	2.08	4.04	0.50	2.35	0.30	-2.93	1.92	0.24
CL# 3A.11	11.07	1.57	8.59	1.80	3.57	0.43	2.16	0.26	-1.83	1.61	0.18
CL# 3A.12	7.97	1.09	6.03	1.24	2.46	0.30	1.51	0.18	-0.74	-62.48	0.09
CL# 3A.13	3.24	0.42	2.16	0.44	0.90	0.11	0.52	0.06	0.92	-49.85	0.06
CL# 3A.14	9.72	1.35	7.32	1.54	3.09	0.39	1.87	0.22	-2.51	1.51	0.14
CL# 3A.15	28.90	3.85	20.81	4.40	8.71	1.09	5.19	0.64	2.76	-83.83	0.43
CL# 3A.16	1.91	0.24	1.30	0.29	0.60	0.08	0.37	0.05	-4.35	0.41	0.05
Average	13.10	1.80	9.89	2.06	4.08	0.51	2.42	0.30	-0.75	-18.78	0.20
St. Deviation	10.25	1.41	7.76	1.64	3.22	0.40	1.89	0.23	2.52	32.22	0.13
2 Σ of Mean	5.13	0.70	3.88	0.82	1.61	0.20	0.95	0.12	1.26	16.11	0.06
% St. Deviation	78.28	77.94	78.48	79.70	78.98	78.64	78.29	78.06	-334.92	-171.60	63.52

APPENDIX B.2.17:

Percent relative standard deviation values for each element analyzed during ICP-MS analysis of individual apatite phenocrysts from within Sprout Brook K-bentonite layer CL# 3(A) from Cobleskill, New York. These percent values are generated during the 16 analytical passes, each containing 5 replicate analyses, for each individual crystal analyzed

Sample Name	P	Ca	Sr	Y	La	Ce	Pr	Nd	Sm
CL# 3A.01	4.95	3.11	2.32	1.84	197.62	1.22	1.75	1.38	5.06
CL# 3A.02	2.01	1.24	1.16	1.64	73.90	2.12	2.37	1.95	2.77
CL# 3A.03	3.12	1.82	0.89	1.51	515.47	1.88	1.25	1.28	2.74
CL# 3A.04	5.15	4.95	2.32	1.37	135.16	2.31	1.09	2.64	3.37
CL# 3A.05	2.04	2.48	1.33	2.09	1653.91	2.52	1.00	1.62	3.98
CL# 3A.06	3.41	3.22	2.47	3.96	1659.01	1.21	1.73	1.65	4.36
CL# 3A.07	3.41	4.81	2.32	1.79	307.60	1.85	2.38	1.21	5.38
CL# 3A.08	1.73	1.15	1.63	1.56	1361.57	0.39	1.73	1.28	1.96
CL# 3A.09	2.54	3.46	2.37	2.00	303.59	1.43	1.75	2.51	2.09
CL# 3A.10	2.94	2.24	1.35	2.72	134.95	1.07	1.29	2.17	2.54
CL# 3A.11	2.21	0.84	3.05	2.22	71.73	2.36	2.01	1.69	2.92
CL# 3A.12	4.55	6.09	1.94	2.15	63.25	1.48	1.42	2.01	3.23
CL# 3A.13	3.64	5.47	2.74	2.20	62.55	1.39	3.69	2.72	5.28
CL# 3A.14	3.61	3.13	3.16	2.45	100.28	0.98	2.31	2.53	5.02
CL# 3A.15	3.01	1.32	1.42	2.75	101.85	0.98	1.02	2.12	1.67
CL# 3A.16	7.44	3.60	3.50	1.17	58.80	4.65	1.23	3.70	3.12

Sample Name	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Pb	Th	U
CL# 3A.01	1.14	3.66	4.34	2.81	3.15	2.25	2.70	3.46	3.06	4.83	16.98	233.70
CL# 3A.02	0.51	3.08	2.83	2.66	1.89	1.88	2.08	2.54	4.20	3.58	25.80	233.58
CL# 3A.03	2.08	3.80	2.61	2.05	2.83	3.29	2.19	1.86	2.92	6.29	24.40	5.55
CL# 3A.04	3.76	6.40	2.95	1.83	1.76	2.90	5.10	2.36	4.27	5.07	12.10	3.71
CL# 3A.05	2.59	4.59	2.91	2.07	3.65	4.09	4.99	2.12	3.66	3.21	12.28	8.11
CL# 3A.06	2.52	3.18	2.91	2.02	4.33	4.93	6.67	3.68	4.31	3.24	4.46	7.94
CL# 3A.07	1.38	3.72	1.98	2.81	4.70	2.40	3.10	2.16	3.49	4.41	30.82	5.30
CL# 3A.08	2.23	2.43	2.12	3.61	3.51	2.05	2.15	2.54	2.24	1.83	19.06	2.50
CL# 3A.09	2.62	3.61	2.74	1.65	1.30	3.61	3.32	1.79	2.89	3.66	4.82	6.78
CL# 3A.10	1.63	3.07	2.88	0.93	2.91	1.67	4.17	2.16	3.36	3.37	6.48	3.53
CL# 3A.11	0.55	2.65	2.54	2.38	1.65	1.73	2.12	2.58	4.74	2.62	11.19	23.68
CL# 3A.12	2.40	2.07	1.84	2.19	0.84	0.75	1.96	5.78	2.35	2.57	6.53	228.07
CL# 3A.13	2.83	12.39	2.89	3.92	6.61	6.72	3.68	3.62	6.10	7.67	13.97	224.99
CL# 3A.14	4.46	2.94	1.83	2.92	3.76	4.30	3.41	4.93	5.43	4.54	3.73	5.00
CL# 3A.15	1.58	4.30	1.49	1.68	1.60	1.98	1.08	2.80	1.62	2.54	4.09	239.23
CL# 3A.16	3.68	3.93	7.16	4.57	1.94	5.79	8.39	2.39	5.69	2.50	3.74	4.46

APPENDIX B.2.18:

Rare earth element ratios derived from trace element concentration values found in Appendix B.2.16. for individual apatite phenocrysts from the Sprout Brook K-bentonite layer CL# 3(A) from Locality A near Cobleskill, New York. Mean, standard deviation, 2 Sigma standard error of the mean, and percent standard deviation values for trace elements are below each ratio.

Sample Name	Ce/La	Ce/Pr	Nd/Pr	Nd/Sm	Gd/Sm	Gd/Tb	Dy/Tb	Dy/Ho	Er/Ho	Er/Tm	Yb/Tm	Yb/Lu
CL# 3A.01	2.65	6.07	5.79	4.09	1.05	7.18	5.53	4.80	1.98	7.85	4.60	8.00
CL# 3A.02	2.70	6.14	5.66	3.97	1.03	7.12	5.51	4.71	1.94	7.90	4.68	8.21
CL# 3A.03	2.68	6.13	5.85	4.10	1.07	7.41	5.57	4.91	2.03	8.33	4.78	7.98
CL# 3A.04	2.70	6.04	5.65	3.86	1.02	7.28	5.57	4.86	2.00	8.19	4.77	7.89
CL# 3A.05	3.02	5.71	5.68	3.16	1.03	7.05	5.09	5.57	2.03	7.89	5.10	8.08
CL# 3A.06	2.68	6.17	5.62	4.03	1.09	7.50	5.52	4.87	2.03	8.14	4.71	8.04
CL# 3A.07	2.67	6.12	5.69	4.01	1.05	7.30	5.55	4.80	2.00	8.20	4.83	8.29
CL# 3A.08	2.66	6.14	5.88	4.13	1.05	7.25	5.53	4.78	1.97	8.15	4.78	8.16
CL# 3A.09	2.65	6.00	5.92	4.07	1.03	7.06	5.58	4.83	1.97	7.94	4.66	8.02
CL# 3A.10	2.71	6.11	5.72	4.02	1.05	7.08	5.46	4.77	1.94	8.05	4.69	7.88
CL# 3A.11	2.64	6.12	5.78	4.05	1.05	7.06	5.48	4.76	1.98	8.23	4.97	8.38
CL# 3A.12	2.70	6.11	5.82	3.90	1.03	7.28	5.51	4.87	1.98	8.08	4.97	8.29
CL# 3A.13	2.83	5.90	5.77	3.84	1.02	7.66	5.10	4.90	2.05	8.11	4.71	8.08
CL# 3A.14	2.68	6.11	5.59	3.84	1.04	7.22	5.44	4.76	2.01	7.93	4.82	8.48
CL# 3A.15	2.66	6.12	5.87	4.01	1.08	7.52	5.41	4.73	1.98	8.00	4.77	8.06
CL# 3A.16	2.61	6.26	5.74	4.31	1.15	7.89	5.36	4.45	2.05	7.86	4.87	7.84
AVERAGE	2.70	6.08	5.75	3.96	1.05	7.30	5.45	4.84	2.00	8.05	4.79	8.11
St. Deviation	0.10	0.13	0.10	0.25	0.03	0.24	0.15	0.22	0.03	0.15	0.13	0.18
2 Σ of Mean	0.05	0.06	0.05	0.12	0.02	0.12	0.08	0.11	0.02	0.07	0.07	0.09
% St. Deviation	3.58	2.07	1.72	6.23	3.15	3.26	2.77	4.65	1.74	1.83	2.72	2.27

APPENDIX B.3.1:

Trace element concentrations obtained from ICP-MS analysis of individual apatite phenocrysts from within the Sprout Brook K-bentonite layer CL# 4(a) from Cobleskill, New York. Since individual crystal weights could not be measured, values shown have no units. Average, standard deviation, 2 sigma standard error of the mean, and percent standard deviation values are shown below each analyte used in further analyses.

Sample Name	P	Ca	Ca/P*	Sr	Y	La	Ce	Pr	Nd	Sm	Eu
CL# 4(a).01	14748.87	29970.72	0.96	13.59	37.62	43.11	141.80	25.99	155.97	54.56	2.97
CL# 4(a).02	13631.11	28328.20	0.98	11.55	29.41	36.07	114.56	21.47	131.32	45.81	2.40
CL# 4(a).03	3129.62	6658.51	1.01	3.18	7.25	8.49	28.34	5.03	30.03	10.42	0.55
CL# 4(a).04	6904.91	14790.40	1.01	6.31	15.19	19.11	61.57	11.47	71.58	23.84	1.20
CL# 4(a).05	5817.95	12166.60	0.99	5.62	14.32	16.92	54.27	10.16	61.96	21.55	1.15
CL# 4(a).06	4318.29	8457.80	0.93	3.36	8.51	11.48	37.41	6.72	40.19	14.19	0.65
CL# 4(a).07	5032.21	10644.11	1.00	4.31	11.79	15.28	50.18	9.16	53.43	18.75	0.87
CL# 4(a).08	3341.00	7817.81	1.11	3.73	7.05	9.67	30.73	5.54	33.58	11.18	0.56
CL# 4(a).09	10200.92	20949.23	0.97	7.80	20.97	31.90	102.68	19.01	115.16	39.32	1.63
CL# 4(a).10	6845.64	14018.59	0.97	5.94	13.62	20.50	67.28	11.84	68.29	23.91	1.07
CL# 4(a).11	7595.18	15737.07	0.98	6.49	17.30	23.04	72.55	13.32	84.60	27.72	1.44
CL# 4(a).12	9145.15	18710.72	0.97	7.62	24.00	25.06	81.87	14.89	87.53	31.70	1.73
CL# 4(a).13	2799.14	5646.47	0.95	1.95	7.81	8.84	28.71	5.26	31.60	10.66	0.60
CL# 4(a).14	2531.10	5608.19	1.05	2.02	3.81	6.83	20.98	3.88	23.60	8.04	0.33
CL# 4(a).15	1139.24	2560.04	1.06	0.84	1.88	3.53	11.07	2.02	12.17	4.06	0.16
CL# 4(a).16	5206.17	11004.45	1.00	4.18	7.98	14.28	44.90	8.06	48.36	16.13	0.71
CL# 4(a).17	3253.40	6902.65	1.00	2.72	6.70	9.74	30.26	5.45	32.39	10.95	0.51
CL# 4(a).18	2937.67	6492.84	1.05	2.67	5.47	8.94	28.80	5.11	29.11	10.22	0.45
CL# 4(a).19	2578.43	5811.26	1.07	2.25	4.37	7.72	24.46	4.35	25.98	8.97	0.38
CL# 4(a).20	4218.00	8726.17	0.98	3.89	7.96	12.68	39.89	7.22	42.97	14.62	0.68
CL# 4(a).21	2282.01	5433.65	1.13	2.70	4.42	6.46	19.80	3.54	21.74	7.45	0.33
CL# 4(a).22	1976.98	4434.84	1.06	1.59	3.97	5.70	18.45	3.30	18.80	6.52	0.29
CL# 4(a).23	2169.91	4811.68	1.05	1.63	3.18	6.26	20.14	3.63	20.92	7.30	0.31
CL# 4(a).24	4776.41	9894.93	0.98	4.03	9.47	13.31	43.07	7.79	44.60	15.66	0.67
CL# 4(a).25	2070.99	4344.99	0.99	1.48	3.49	5.92	19.48	3.39	18.59	6.95	0.28
CL# 4(a).26	2310.15	4754.90	0.97	1.80	3.66	6.70	22.03	3.90	22.40	7.85	0.35
CL# 4(a).27	2561.02	5262.55	0.97	1.90	4.33	7.49	24.59	4.35	25.73	8.74	0.39
CL# 4(a).28	2811.01	5741.54	0.97	2.04	4.16	8.21	26.66	4.77	26.44	9.46	0.40
CL# 4(a).29	2904.51	6050.93	0.99	2.32	6.30	8.45	27.88	4.98	27.74	10.08	0.45
CL# 4(a).30	2538.62	5269.57	0.98	1.69	3.58	7.31	23.15	4.17	23.29	8.38	0.32
CL# 4(a).31	2354.17	5572.29	1.12	2.96	4.02	6.61	21.48	3.88	21.56	7.97	0.31
CL# 4(a).32	461.62	1080.62	1.11	0.54	0.99	1.51	4.64	0.88	4.89	1.66	0.08
CL# 4(a).33	406.84	927.09	1.08	0.30	0.85	1.23	3.96	0.69	4.07	1.43	0.07
		Average		3.79	9.26	12.68	40.84	7.43	44.26	15.34	0.74
		St. Deviation		2.99	8.42	9.74	31.60	5.86	35.74	12.39	0.66
		2 Σ of Mean		1.04	2.93	3.39	11.00	2.04	12.44	4.31	0.23
		% St. Deviation		78.97	91.00	76.86	77.38	78.81	80.74	80.79	89.47

APPENDIX B.3.1 continued

Sample Name	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Pb	Th	U
CL# 4(a).01	45.25	4.52	13.38	1.58	2.55	0.21	1.19	0.16	-0.55	5.92	1.35
CL# 4(a).02	38.46	3.81	11.52	1.38	2.09	0.18	1.01	0.12	-0.78	3.41	1.15
CL# 4(a).03	8.63	0.82	2.36	0.29	0.43	0.04	0.26	0.04	0.40	0.77	0.27
CL# 4(a).04	19.56	1.89	5.59	0.61	1.14	0.09	0.53	0.06	-1.08	1.35	0.67
CL# 4(a).05	17.88	1.72	5.17	0.62	0.94	0.08	0.56	0.06	-1.49	2.57	0.48
CL# 4(a).06	11.49	1.09	3.15	0.35	0.53	0.06	0.30	0.04	-1.00	0.73	0.34
CL# 4(a).07	15.10	1.36	3.80	0.43	0.70	0.07	0.37	0.05	3.49	0.71	0.44
CL# 4(a).08	9.45	0.85	2.35	0.27	0.49	0.05	0.24	0.04	5.71	0.97	0.29
CL# 4(a).09	32.54	2.92	7.78	0.79	1.29	0.11	0.68	0.09	-0.53	1.58	0.75
CL# 4(a).10	19.48	1.72	4.70	0.59	0.89	0.08	0.50	0.07	2.42	0.70	0.59
CL# 4(a).11	23.33	2.14	6.15	0.72	1.16	0.09	0.53	0.07	0.07	1.74	0.61
CL# 4(a).12	27.40	2.73	8.58	1.02	1.54	0.13	0.73	0.09	-0.60	3.32	0.87
CL# 4(a).13	9.33	0.87	2.63	0.33	0.49	0.04	0.25	0.03	-0.99	0.87	0.29
CL# 4(a).14	6.62	0.60	1.53	0.14	0.23	0.02	0.14	0.01	0.50	0.21	0.20
CL# 4(a).15	3.37	0.29	0.74	0.07	0.12	0.01	0.06	0.01	0.26	0.09	0.08
CL# 4(a).16	13.61	1.22	3.21	0.31	0.54	0.04	0.27	0.03	0.75	0.33	0.37
CL# 4(a).17	9.00	0.86	2.50	0.28	0.48	0.05	0.23	0.03	-0.03	0.36	0.27
CL# 4(a).18	8.15	0.79	2.04	0.22	0.38	0.03	0.26	0.03	0.76	0.30	0.20
CL# 4(a).19	7.25	0.67	1.67	0.18	0.29	0.02	0.16	0.02	0.23	0.20	0.18
CL# 4(a).20	11.68	1.09	2.77	0.31	0.48	0.05	0.25	0.03	2.22	0.59	0.29
CL# 4(a).21	5.88	0.58	1.57	0.18	0.30	0.03	0.16	0.02	2.26	0.31	0.17
CL# 4(a).22	5.49	0.52	1.42	0.15	0.28	0.02	0.14	0.02	0.48	0.18	0.16
CL# 4(a).23	5.81	0.55	1.40	0.13	0.22	0.01	0.10	0.01	0.04	0.14	0.14
CL# 4(a).24	13.51	1.24	3.26	0.37	0.56	0.05	0.31	0.03	-0.35	0.55	0.41
CL# 4(a).25	5.86	0.51	1.23	0.12	0.19	0.02	0.10	0.01	-0.58	0.10	0.19
CL# 4(a).26	6.55	0.60	1.51	0.15	0.25	0.02	0.13	0.03	-0.65	0.18	0.17
CL# 4(a).27	7.36	0.65	1.64	0.17	0.29	0.03	0.14	0.02	-0.78	0.18	0.18
CL# 4(a).28	7.78	0.70	1.66	0.16	0.25	0.02	0.10	0.02	-0.37	0.11	0.21
CL# 4(a).29	8.36	0.76	2.04	0.24	0.41	0.04	0.20	0.02	-0.56	0.30	0.21
CL# 4(a).30	6.92	0.62	1.40	0.13	0.21	0.02	0.10	0.01	-0.73	0.10	0.19
CL# 4(a).31	6.44	0.58	1.51	0.14	0.26	0.02	0.12	0.02	0.57	0.22	0.19
CL# 4(a).32	1.31	0.13	0.37	0.04	0.07	0.01	0.03	0.00	0.82	0.04	0.04
CL# 4(a).33	1.19	0.11	0.31	0.04	0.04	0.01	0.02	0.00	-0.49	0.04	0.03
Average	12.73	1.20	3.36	0.38	0.61	0.05	0.31	0.04	0.29	0.88	0.36
St. Deviation	10.37	1.02	3.07	0.37	0.57	0.05	0.28	0.03	1.48	1.26	0.30
2 Σ of Mean	3.61	0.35	1.07	0.13	0.20	0.02	0.10	0.01	0.52	0.44	0.11
% St. Deviation	81.44	85.06	91.40	96.91	94.32	90.74	89.30	89.16	519.21	143.01	84.00

APPENDIX B.3.2:

Percent relative standard deviation values for each element analyzed during ICP-MS analysis of individual apatite phenocrysts from within Sprout Brook K-bentonite layer CL# 4(a) from Cobleskill, New York. These percent values are generated during the 16 analytical passes, each containing 5 replicate analyses, for each individual crystal analyzed

Sample Name	P	Ca	Sr	Y	La	Ce	Pr	Nd	Sm
CL# 4(a).01	5.56	5.01	1.88	3.32	3.33	1.86	2.26	5.31	3.94
CL# 4(a).02	1.42	3.20	0.54	3.08	1.69	1.76	1.39	5.37	2.01
CL# 4(a).03	5.28	5.26	2.36	3.62	3.63	1.44	1.65	2.99	1.10
CL# 4(a).04	2.51	4.53	1.12	3.78	2.08	2.80	1.20	5.69	2.74
CL# 4(a).05	2.01	2.67	1.55	1.23	1.70	1.15	2.11	6.81	1.61
CL# 4(a).06	4.56	1.61	5.12	5.75	1.98	2.15	1.39	5.75	3.27
CL# 4(a).07	3.52	5.41	1.46	2.69	2.60	1.78	2.16	5.06	3.89
CL# 4(a).08	3.89	2.92	3.33	2.36	1.69	1.42	1.83	2.47	2.03
CL# 4(a).09	3.68	2.80	2.26	2.40	2.77	2.21	1.81	2.39	1.98
CL# 4(a).10	2.34	2.21	2.20	5.81	0.72	1.63	2.07	2.07	2.87
CL# 4(a).11	2.10	1.55	1.27	3.11	0.91	2.93	2.05	1.24	2.43
CL# 4(a).12	3.29	1.41	1.24	2.18	2.30	2.89	1.07	3.55	1.54
CL# 4(a).13	1.32	1.43	3.20	3.36	3.15	2.38	3.01	5.74	1.13
CL# 4(a).14	7.32	6.88	7.11	5.43	5.86	6.24	8.40	10.24	8.11
CL# 4(a).15	9.56	7.77	7.04	7.85	8.79	8.20	9.18	10.25	5.80
CL# 4(a).16	38.42	39.00	37.27	38.59	48.80	49.86	50.60	51.01	49.52
CL# 4(a).17	21.73	24.95	22.64	22.31	32.29	32.46	33.06	35.76	33.63
CL# 4(a).18	9.98	9.66	7.19	10.90	15.94	16.14	15.08	16.49	15.74
CL# 4(a).19	15.56	16.40	14.80	18.62	22.86	21.10	23.18	25.50	24.01
CL# 4(a).20	18.31	16.78	14.95	16.37	20.75	20.29	21.61	22.22	21.06
CL# 4(a).21	13.47	13.67	9.51	14.07	17.46	20.27	19.43	22.43	19.13
CL# 4(a).22	9.34	8.29	7.76	12.49	10.93	9.92	10.28	13.52	9.36
CL# 4(a).23	7.09	5.78	5.66	7.51	7.32	7.85	10.85	9.15	8.89
CL# 4(a).24	3.39	2.65	2.55	2.39	1.45	1.33	1.25	4.29	1.31
CL# 4(a).25	2.05	4.66	2.34	5.37	1.32	1.38	1.85	5.49	3.54
CL# 4(a).26	2.80	3.20	2.12	2.96	3.61	1.25	1.82	5.91	3.33
CL# 4(a).27	1.41	1.56	3.99	2.74	3.00	2.96	2.82	3.63	3.96
CL# 4(a).28	3.86	4.01	2.00	6.53	2.71	2.40	2.61	6.97	3.40
CL# 4(a).29	1.77	2.74	2.40	2.57	1.77	2.66	1.39	3.79	3.59
CL# 4(a).30	1.43	2.58	2.16	4.20	1.79	2.55	2.43	3.52	3.33
CL# 4(a).31	1.46	1.62	2.25	4.11	2.52	1.65	1.13	3.81	2.11
CL# 4(a).32	4.28	14.71	4.65	7.91	5.02	4.44	4.12	7.62	6.35
CL# 4(a).33	5.60	10.22	4.54	5.02	5.78	5.52	1.85	9.44	13.98

APPENDIX B.3.2 continued

Sample Name	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Pb	Th	U
CL# 4(a).01	2.94	3.20	1.75	1.61	2.88	7.48	7.02	10.36	10.57	7.86	7.91	5.35
CL# 4(a).02	1.77	2.58	2.07	4.15	2.74	8.44	4.80	7.37	5.06	8.75	6.28	1.92
CL# 4(a).03	12.40	2.32	1.64	4.86	5.57	13.22	4.89	5.22	37.41	27.26	11.34	4.31
CL# 4(a).04	1.87	2.39	2.75	10.58	2.00	26.23	6.59	17.13	7.89	3.30	5.41	8.40
CL# 4(a).05	2.09	3.09	2.27	2.60	2.06	2.36	6.02	28.18	17.65	2.56	5.31	3.67
CL# 4(a).06	2.89	2.43	4.50	6.29	7.74	15.40	14.49	7.47	11.65	2.10	4.41	2.65
CL# 4(a).07	1.86	4.31	1.94	4.77	13.42	5.32	9.14	8.31	6.16	3.32	8.67	2.51
CL# 4(a).08	4.23	1.71	1.57	2.75	5.83	4.77	12.11	5.82	12.25	3.80	3.36	6.23
CL# 4(a).09	3.47	2.66	2.29	1.63	2.19	8.31	7.74	8.40	7.91	7.54	3.80	2.57
CL# 4(a).10	3.94	2.23	1.83	4.05	21.32	7.45	6.52	2.63	4.38	2.97	7.27	5.75
CL# 4(a).11	2.76	1.72	3.12	3.11	4.06	5.63	9.71	6.06	9.17	85.84	4.11	1.99
CL# 4(a).12	2.76	2.08	0.99	5.44	7.10	4.67	12.17	4.27	13.39	6.31	3.33	6.94
CL# 4(a).13	3.74	2.63	1.74	4.35	11.62	9.99	16.67	9.50	8.72	2.20	6.26	9.43
CL# 4(a).14	9.08	6.78	5.89	3.55	10.25	16.04	24.58	21.60	20.97	8.67	6.70	13.74
CL# 4(a).15	11.96	6.61	11.90	14.32	9.26	21.51	27.58	31.54	19.00	22.31	13.34	18.11
CL# 4(a).16	45.92	49.38	46.60	43.80	36.07	39.31	29.36	29.33	36.45	10.81	26.73	49.68
CL# 4(a).17	29.56	32.77	31.83	26.20	24.34	29.75	18.25	22.70	19.82	144.86	14.48	17.03
CL# 4(a).18	16.88	14.89	17.37	13.80	4.30	17.16	13.46	51.09	17.16	7.82	18.98	23.54
CL# 4(a).19	21.50	24.45	22.87	19.48	23.60	19.97	5.03	17.44	35.79	33.44	23.19	25.67
CL# 4(a).20	17.88	19.18	17.55	17.35	11.35	13.49	22.70	12.51	13.01	3.09	12.63	21.43
CL# 4(a).21	17.15	19.36	20.48	14.22	18.78	13.66	26.36	17.93	17.79	5.79	8.26	21.77
CL# 4(a).22	10.94	8.42	11.23	8.39	7.98	9.91	11.22	17.22	16.52	8.09	15.10	21.53
CL# 4(a).23	6.63	10.02	10.32	9.02	10.72	18.70	30.17	8.80	21.21	107.34	6.87	11.04
CL# 4(a).24	5.51	3.03	1.29	5.08	4.95	8.48	13.91	11.08	3.82	9.49	7.53	5.24
CL# 4(a).25	4.84	3.36	2.94	10.05	11.17	23.39	18.32	13.23	27.45	4.51	9.73	24.59
CL# 4(a).26	3.34	1.76	4.83	9.55	7.03	22.73	17.84	23.69	78.29	3.34	7.36	6.53
CL# 4(a).27	3.69	2.12	1.34	9.65	3.61	9.68	18.72	15.31	12.43	4.67	7.18	6.51
CL# 4(a).28	6.91	2.17	2.10	5.17	8.97	12.63	10.05	17.31	26.29	4.56	18.56	10.81
CL# 4(a).29	6.57	2.71	2.36	8.31	9.79	15.64	8.56	10.11	13.71	5.88	10.96	5.47
CL# 4(a).30	7.29	3.79	2.81	3.76	12.20	13.68	23.70	16.31	19.87	4.44	18.66	17.38
CL# 4(a).31	3.19	5.69	1.52	5.33	7.12	9.74	18.60	8.48	21.66	15.63	3.92	8.06
CL# 4(a).32	9.36	2.93	6.94	15.33	14.54	32.45	71.67	75.24	76.52	6.34	18.10	15.35
CL# 4(a).33	15.17	11.15	4.49	4.14	18.81	43.53	47.72	59.01	71.30	8.47	11.66	23.36

APPENDIX B.3.3:

Rare earth element ratios derived from trace element concentration values found in Appendix B.3.1. for individual apatite phenocrysts from the Sprout Brook K-bentonite layer CL# 4(a) from Locality A near Cobleskill, New York. Mean, standard deviation, 2 Sigma standard error of the mean, and percent standard deviation values for trace elements are below each ratio.

Sample Name	Ce/La	Ce/Pr	Nd/Pr	Nd/Sm	Gd/Sm	Gd/Tb
CL# 4(a).01	3.29	5.46	6.00	2.86	0.83	10.02
CL# 4(a).02	3.18	5.34	6.12	2.87	0.84	10.10
CL# 4(a).03	3.34	5.63	5.97	2.88	0.83	10.59
CL# 4(a).04	3.22	5.37	6.24	3.00	0.82	10.34
CL# 4(a).05	3.21	5.34	6.10	2.87	0.83	10.40
CL# 4(a).06	3.26	5.56	5.98	2.83	0.81	10.58
CL# 4(a).07	3.28	5.48	5.83	2.85	0.81	11.09
CL# 4(a).08	3.18	5.54	6.06	3.00	0.85	11.18
CL# 4(a).09	3.22	5.40	6.06	2.93	0.83	11.15
CL# 4(a).10	3.28	5.68	5.77	2.86	0.81	11.31
CL# 4(a).11	3.15	5.45	6.35	3.05	0.84	10.92
CL# 4(a).12	3.27	5.50	5.88	2.76	0.86	10.02
CL# 4(a).13	3.25	5.46	6.01	2.97	0.88	10.77
CL# 4(a).14	3.07	5.41	6.09	2.93	0.82	11.13
CL# 4(a).15	3.14	5.48	6.03	2.99	0.83	11.48
CL# 4(a).16	3.15	5.57	6.00	3.00	0.84	11.12
CL# 4(a).17	3.11	5.55	5.94	2.96	0.82	10.49
CL# 4(a).18	3.22	5.64	5.70	2.85	0.80	10.36
CL# 4(a).19	3.17	5.62	5.97	2.90	0.81	10.85
CL# 4(a).20	3.15	5.52	5.95	2.94	0.80	10.76
CL# 4(a).21	3.07	5.59	6.14	2.92	0.79	10.12
CL# 4(a).22	3.24	5.59	5.70	2.89	0.84	10.62
CL# 4(a).23	3.22	5.55	5.76	2.87	0.80	10.49
CL# 4(a).24	3.24	5.53	5.72	2.85	0.86	10.92
CL# 4(a).25	3.29	5.75	5.48	2.67	0.84	11.45
CL# 4(a).26	3.29	5.64	5.74	2.85	0.83	10.97
CL# 4(a).27	3.28	5.65	5.92	2.94	0.84	11.35
CL# 4(a).28	3.25	5.59	5.54	2.79	0.82	11.07
CL# 4(a).29	3.30	5.59	5.57	2.75	0.83	11.06
CL# 4(a).30	3.17	5.55	5.58	2.78	0.83	11.22
CL# 4(a).31	3.25	5.54	5.56	2.71	0.81	11.16
CL# 4(a).32	3.08	5.30	5.58	2.95	0.79	10.34
CL# 4(a).33	3.21	5.72	5.89	2.86	0.83	10.72
AVERAGE	3.21	5.53	5.89	2.88	0.83	10.79
St. Deviation	0.07	0.11	0.22	0.09	0.02	0.42
2 Σ of Mean	0.02	0.04	0.08	0.03	0.01	0.15
% St. Deviation	2.22	1.99	3.70	3.05	2.53	3.94

APPENDIX B.3.3 continued

Sample Name	Dy/Tb	Dy/Ho	Er/Ho	Er/Tm	Yb/Tm	Yb/Lu
CL# 4(a).01	2.96	8.46	1.61	12.28	5.75	7.70
CL# 4(a).02	3.03	8.35	1.52	11.32	5.44	8.06
CL# 4(a).03	2.89	8.21	1.49	9.90	6.04	6.28
CL# 4(a).04	2.96	9.10	1.85	12.53	5.89	9.10
CL# 4(a).05	3.01	8.28	1.50	11.50	6.86	9.96
CL# 4(a).06	2.90	8.99	1.52	9.52	5.44	8.11
CL# 4(a).07	2.79	8.92	1.65	10.20	5.30	7.74
CL# 4(a).08	2.77	8.65	1.81	10.56	5.24	6.44
CL# 4(a).09	2.67	9.82	1.63	11.39	6.05	7.54
CL# 4(a).10	2.73	8.00	1.52	11.00	6.14	7.56
CL# 4(a).11	2.88	8.58	1.62	12.79	5.83	7.50
CL# 4(a).12	3.14	8.42	1.51	11.92	5.63	8.15
CL# 4(a).13	3.04	7.99	1.48	11.41	5.78	7.91
CL# 4(a).14	2.58	10.84	1.60	13.24	8.11	9.40
CL# 4(a).15	2.51	11.00	1.82	15.79	7.15	7.92
CL# 4(a).16	2.62	10.47	1.75	12.93	6.52	7.85
CL# 4(a).17	2.92	9.00	1.72	10.31	4.97	7.43
CL# 4(a).18	2.59	9.22	1.74	11.72	7.96	9.85
CL# 4(a).19	2.49	9.26	1.59	12.71	7.10	6.98
CL# 4(a).20	2.55	9.05	1.57	9.67	5.06	7.83
CL# 4(a).21	2.71	8.79	1.66	10.18	5.54	8.72
CL# 4(a).22	2.75	9.59	1.89	11.73	5.82	7.82
CL# 4(a).23	2.53	10.94	1.69	14.70	6.72	8.68
CL# 4(a).24	2.63	8.71	1.49	10.16	5.56	8.83
CL# 4(a).25	2.40	10.19	1.60	12.29	6.23	10.64
CL# 4(a).26	2.54	9.90	1.63	11.49	5.85	4.97
CL# 4(a).27	2.53	9.74	1.70	11.24	5.64	8.69
CL# 4(a).28	2.37	10.33	1.58	11.82	4.84	6.35
CL# 4(a).29	2.70	8.63	1.73	10.02	4.94	9.24
CL# 4(a).30	2.28	10.85	1.63	12.09	5.79	8.46
CL# 4(a).31	2.62	10.97	1.86	12.36	5.82	7.48
CL# 4(a).32	2.94	9.42	1.84	11.06	3.92	7.09
CL# 4(a).33	2.81	8.53	1.21	7.33	2.82	3.93
AVERAGE	2.72	9.31	1.64	11.49	5.81	7.89
St. Deviation	0.22	0.94	0.14	1.56	1.01	1.35
2 Σ of Mean	0.08	0.33	0.05	0.54	0.35	0.47
% St. Deviation	7.92	10.10	8.74	13.60	17.42	17.09

APPENDIX B.3.4:

Trace element concentrations obtained from ICP-MS analysis of individual apatite phenocrysts from within the Sprout Brook K-bentonite layer CL# 4(b) from Cobleskill, New York. Since individual crystal weights could not be measured, values shown have no units. Average, standard deviation, 2 sigma standard error of the mean, and percent standard deviation values are shown below each analyte used in further analyses.

Sample Name	P	Ca	Ca/P*	Sr	Y	La	Ce	Pr	Nd	Sm	Eu
CL# 4(b).01	5465.97	11435.97	0.99	3.81	60.26	32.86	85.49	13.57	77.19	17.01	0.88
CL# 4(b).02	4133.66	8592.99	0.98	2.86	37.73	21.40	55.03	8.95	50.60	11.31	0.62
CL# 4(b).03	1996.76	4275.71	1.01	1.64	15.26	8.62	21.48	3.55	20.14	4.47	0.28
CL# 4(b).04	1003.64	2213.44	1.04	0.86	8.35	4.74	12.39	1.95	10.64	2.47	0.16
CL# 4(b).05	12210.71	24754.59	0.96	8.12	118.62	65.43	170.30	27.60	156.14	35.53	1.92
CL# 4(b).06	1604.41	3469.71	1.02	1.38	15.87	8.75	22.79	3.66	20.49	4.55	0.23
CL# 4(b).07	761.54	1721.97	1.07	0.67	10.99	5.72	15.20	2.47	14.04	3.20	0.18
CL# 4(b).08	1398.78	2893.64	0.98	0.91	14.91	8.26	21.40	3.42	19.43	4.29	0.23
CL# 4(b).09	1887.37	3760.24	0.94	1.24	19.70	10.86	28.41	4.55	24.12	5.82	0.30
CL# 4(b).10	5193.51	10884.97	0.99	4.68	54.01	28.29	74.66	11.90	66.48	15.15	0.85
CL# 4(b).11	1303.60	2637.46	0.96	0.84	9.80	5.52	14.15	2.29	12.56	2.96	0.19
CL# 4(b).12	4276.66	8423.15	0.93	2.76	37.96	21.19	55.59	8.91	49.51	11.27	0.60
CL# 4(b).13	476.10	1136.03	1.13	0.38	5.48	2.75	7.41	1.21	6.43	1.52	0.10
CL# 4(b).14	2588.20	5310.58	0.97	1.69	24.78	13.20	34.85	5.45	30.90	7.01	0.39
CL# 4(b).15	1817.21	3640.52	0.95	1.26	12.48	5.75	15.05	2.49	14.28	3.26	0.39
CL# 4(b).16	5429.57	10842.60	0.94	3.55	42.13	21.11	55.21	8.76	48.43	11.05	0.90
CL# 4(b).17	10597.26	20983.12	0.94	7.50	72.82	38.36	99.68	15.83	89.28	20.34	1.33
CL# 4(b).18	3683.92	7889.86	1.01	2.55	27.79	16.00	39.56	6.64	41.41	8.83	0.58
CL# 4(b).19	3275.78	7255.77	1.05	1.53	33.04	18.66	46.77	7.79	46.15	9.72	0.48
CL# 4(b).20	5350.69	11827.82	1.05	3.93	27.32	9.48	24.49	4.14	26.43	6.50	1.10
		Average		2.61	32.47	17.35	44.99	7.26	41.23	9.31	0.59
		St. Deviation		2.16	27.41	15.04	39.18	6.30	35.60	8.05	0.47
		2 Σ of Mean		0.97	12.26	6.73	17.52	2.82	15.92	3.60	0.21
		% St. Deviation		82.82	84.43	86.71	87.09	86.80	86.34	86.48	79.45

APPENDIX B.3.4 continued

Sample Name	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Pb	Th	U
CL# 4(b).01	17.94	2.28	12.44	2.71	5.60	0.69	3.25	0.41	0.30	2.01	0.34
CL# 4(b).02	11.76	1.48	8.08	1.72	3.59	0.43	2.02	0.24	0.11	2.21	0.18
CL# 4(b).03	4.67	0.61	3.41	0.70	1.43	0.17	0.83	0.10	1.99	1.30	0.11
CL# 4(b).04	2.66	0.35	1.89	0.40	0.86	0.10	0.44	0.05	9.31	0.37	0.05
CL# 4(b).05	36.37	4.71	25.67	5.50	11.37	1.39	6.63	0.82	-0.06	8.21	0.66
CL# 4(b).06	4.93	0.62	3.31	0.73	1.50	0.17	0.84	0.10	0.39	0.48	0.08
CL# 4(b).07	3.29	0.43	2.32	0.49	1.01	0.12	0.59	0.07	0.07	0.55	0.09
CL# 4(b).08	4.67	0.57	3.18	0.67	1.34	0.17	0.82	0.11	6.90	0.34	0.07
CL# 4(b).09	6.02	0.75	4.08	0.89	1.80	0.23	1.10	0.13	0.18	0.49	0.10
CL# 4(b).10	15.66	2.07	11.54	2.41	4.94	0.61	2.93	0.37	1.35	3.86	0.32
CL# 4(b).11	3.02	0.40	2.21	0.45	0.88	0.11	0.52	0.06	-0.42	0.47	0.05
CL# 4(b).12	11.81	1.51	8.32	1.77	3.53	0.43	2.11	0.26	-0.39	0.89	0.20
CL# 4(b).13	1.73	0.21	1.14	0.24	0.47	0.06	0.26	0.03	-0.01	0.26	0.04
CL# 4(b).14	7.51	0.95	5.25	1.11	2.26	0.26	1.22	0.15	-0.61	0.62	0.13
CL# 4(b).15	3.51	0.48	2.70	0.57	1.27	0.16	0.76	0.09	-0.79	0.51	0.10
CL# 4(b).16	11.97	1.57	8.63	1.86	3.99	0.51	2.42	0.30	-0.57	1.48	0.24
CL# 4(b).17	22.05	2.78	15.19	3.24	6.51	0.81	3.91	0.48	-0.25	5.53	0.37
CL# 4(b).18	9.03	1.15	6.30	1.27	2.52	0.30	1.45	0.17	-1.71	1.10	0.13
CL# 4(b).19	9.96	1.23	6.70	1.47	2.94	0.36	1.70	0.21	-0.28	1.08	0.17
CL# 4(b).20	7.65	0.99	5.45	1.13	2.30	0.30	1.57	0.20	1.66	1.42	0.26
Average	9.81	1.26	6.89	1.47	3.01	0.37	1.77	0.22	0.86	1.66	0.19
St. Deviation	8.32	1.07	5.85	1.26	2.59	0.32	1.52	0.19	2.65	2.02	0.15
2 Σ of Mean	3.72	0.48	2.62	0.56	1.16	0.14	0.68	0.08	1.18	0.90	0.07
% St. Deviation	84.77	85.29	84.92	85.63	86.05	86.07	85.87	87.04	307.99	121.90	80.78

APPENDIX B.3.5:

Percent relative standard deviation values for each element analyzed during ICP-MS analysis of individual apatite phenocrysts from within Sprout Brook K-bentonite layer CL# 4(b) from Cobleskill, New York. These percent values are generated during the 16 analytical passes, each containing 5 replicate analyses, for each individual crystal analyzed.

Sample Name	P	Ca	Sr	Y	La	Ce	Pr	Nd	Sm
CL# 4(b).01	1.79	2.80	1.51	0.71	1.76	1.46	1.00	4.00	2.02
CL# 4(b).02	1.40	2.63	2.41	3.94	1.44	2.27	1.54	1.60	3.83
CL# 4(b).03	2.55	3.59	4.08	1.31	2.96	2.68	2.24	5.67	2.75
CL# 4(b).04	1.59	6.67	2.44	3.30	0.97	1.79	2.80	6.33	4.04
CL# 4(b).05	1.03	1.70	2.65	4.32	1.15	1.39	0.65	3.19	1.55
CL# 4(b).06	0.77	2.97	5.05	3.14	2.12	1.47	2.22	6.35	0.80
CL# 4(b).07	1.77	3.70	4.53	2.58	4.35	2.96	2.82	3.45	4.80
CL# 4(b).08	4.82	7.74	2.75	2.92	2.72	1.49	1.41	3.81	3.97
CL# 4(b).09	2.72	3.40	1.88	2.77	2.02	2.48	3.38	2.45	2.98
CL# 4(b).10	2.34	3.18	1.37	1.87	0.69	1.44	1.28	2.10	2.04
CL# 4(b).11	3.90	5.90	5.20	3.97	1.43	3.29	1.40	3.71	2.36
CL# 4(b).12	1.70	1.93	1.54	2.32	1.50	1.39	2.02	3.84	2.38
CL# 4(b).13	8.54	7.86	6.05	3.65	2.51	3.02	2.36	5.42	2.60
CL# 4(b).14	2.26	1.80	4.42	4.12	1.19	3.25	1.84	1.93	3.21
CL# 4(b).15	2.28	2.62	2.11	2.52	1.57	1.61	3.56	6.30	5.27
CL# 4(b).16	1.29	0.69	1.80	3.17	1.49	2.58	0.59	1.65	2.02
CL# 4(b).17	1.16	0.84	0.86	0.67	1.91	1.36	1.08	2.84	1.23
CL# 4(b).18	6.01	3.07	3.02	5.14	1.22	2.56	0.45	5.61	2.01
CL# 4(b).19	2.98	2.99	2.37	2.66	1.17	2.80	1.49	3.14	2.35
CL# 4(b).20	3.22	2.98	1.96	1.66	1.66	2.01	2.62	3.36	4.97

Sample Name	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Pb	Th	U
CL# 4(b).01	4.33	1.22	2.98	2.58	2.42	1.86	1.97	2.81	3.09	9.89	0.79	3.20
CL# 4(b).02	2.60	3.26	2.83	3.23	4.90	4.58	3.04	3.02	4.69	60.21	2.99	24.88
CL# 4(b).03	9.48	3.66	2.27	4.91	2.61	5.49	9.80	8.20	9.28	2.95	2.61	6.82
CL# 4(b).04	8.46	7.67	3.38	3.61	4.33	8.67	6.07	7.78	6.52	3.19	4.66	18.98
CL# 4(b).05	2.89	2.90	1.63	2.46	2.60	3.41	2.96	3.50	1.20	18.10	4.11	1.70
CL# 4(b).06	9.43	1.71	2.49	5.92	6.38	5.18	10.50	3.50	5.03	6.08	4.51	11.07
CL# 4(b).07	6.96	3.99	4.94	8.30	6.06	4.19	12.31	6.84	6.17	62.51	6.11	42.45
CL# 4(b).08	2.43	1.93	2.34	5.22	2.45	6.90	5.79	7.94	4.10	1.62	6.30	7.02
CL# 4(b).09	6.20	0.52	2.05	2.22	3.71	3.32	7.43	4.53	8.06	18.59	5.01	17.49
CL# 4(b).10	2.11	1.87	1.02	6.94	1.82	4.18	1.92	2.37	6.11	4.45	1.11	10.89
CL# 4(b).11	4.92	5.69	2.34	2.66	3.45	3.33	7.39	6.18	12.85	14.45	6.07	13.79
CL# 4(b).12	3.38	3.10	1.98	8.23	2.23	1.93	5.35	2.86	5.86	14.91	5.19	8.51
CL# 4(b).13	6.72	3.63	4.58	4.57	5.69	10.34	3.97	7.23	17.32	841.03	10.38	19.19
CL# 4(b).14	2.28	2.22	1.51	2.68	2.27	5.09	6.32	5.80	5.84	7.54	6.93	9.00
CL# 4(b).15	6.17	7.81	1.74	6.60	3.81	7.40	8.11	6.58	9.98	2.07	3.50	10.84
CL# 4(b).16	4.34	2.98	2.47	2.63	0.95	2.84	1.57	1.47	3.65	7.38	6.64	3.24
CL# 4(b).17	2.84	1.52	0.90	2.75	2.59	2.44	1.41	4.36	2.63	11.81	0.69	5.23
CL# 4(b).18	3.53	2.02	2.39	3.05	2.42	6.29	3.93	5.35	2.87	2.01	4.29	8.78
CL# 4(b).19	4.11	2.43	1.92	4.40	1.81	2.15	1.58	2.27	7.09	17.53	5.33	6.48
CL# 4(b).20	1.80	4.75	1.47	1.58	2.13	5.75	2.35	6.43	6.24	4.70	7.82	13.21

APPENDIX B.3.6:

Rare earth element ratios derived from trace element concentration values found in Appendix B.3.4 for individual apatite phenocrysts from the Sprout Brook K-bentonite layer CL# 4(b) from Locality A near Cobleskill, New York. Mean, standard deviation, 2 Sigma standard error of the mean, and percent standard deviation values for trace elements are below each ratio.

Sample Name	Ce/La	Ce/Pr	Nd/Pr	Nd/Sm	Gd/Sm	Gd/Tb	Dy/Tb	Dy/Ho	Er/Ho	Er/Tm	Yb/Tm	Yb/Lu
CL# 4(b).01	2.60	6.30	5.69	4.54	1.05	7.86	5.45	4.59	2.07	8.15	4.72	7.90
CL# 4(b).02	2.57	6.15	5.65	4.48	1.04	7.97	5.47	4.70	2.09	8.30	4.67	8.47
CL# 4(b).03	2.49	6.06	5.68	4.50	1.04	7.72	5.63	4.86	2.04	8.28	4.78	8.02
CL# 4(b).04	2.62	6.34	5.45	4.30	1.08	7.54	5.36	4.70	2.14	8.65	4.47	8.09
CL# 4(b).05	2.60	6.17	5.66	4.39	1.02	7.73	5.46	4.67	2.07	8.19	4.77	8.05
CL# 4(b).06	2.61	6.23	5.61	4.50	1.08	7.98	5.36	4.57	2.07	8.71	4.87	8.41
CL# 4(b).07	2.66	6.15	5.69	4.39	1.03	7.71	5.44	4.75	2.06	8.21	4.84	8.27
CL# 4(b).08	2.59	6.26	5.68	4.53	1.09	8.19	5.59	4.73	1.99	7.89	4.82	7.62
CL# 4(b).09	2.62	6.25	5.30	4.15	1.03	7.99	5.42	4.59	2.02	7.85	4.80	8.77
CL# 4(b).10	2.64	6.27	5.59	4.39	1.03	7.57	5.58	4.79	2.05	8.10	4.80	7.94
CL# 4(b).11	2.56	6.17	5.48	4.24	1.02	7.63	5.56	4.94	1.98	8.39	4.95	9.07
CL# 4(b).12	2.62	6.24	5.55	4.39	1.05	7.81	5.50	4.69	1.99	8.18	4.89	8.24
CL# 4(b).13	2.69	6.14	5.32	4.24	1.14	8.13	5.36	4.74	1.95	7.30	4.10	8.15
CL# 4(b).14	2.64	6.39	5.67	4.41	1.07	7.93	5.54	4.72	2.03	8.61	4.66	8.02
CL# 4(b).15	2.62	6.04	5.74	4.38	1.08	7.31	5.64	4.71	2.22	8.17	4.88	8.16
CL# 4(b).16	2.61	6.30	5.53	4.38	1.08	7.62	5.49	4.64	2.14	7.82	4.75	8.12
CL# 4(b).17	2.60	6.30	5.64	4.39	1.08	7.93	5.46	4.68	2.01	8.00	4.81	8.09
CL# 4(b).18	2.47	5.95	6.23	4.69	1.02	7.88	5.50	4.98	1.99	8.42	4.85	8.59
CL# 4(b).19	2.51	6.01	5.93	4.75	1.03	8.11	5.45	4.55	2.00	8.12	4.68	8.02
CL# 4(b).20	2.58	5.91	6.38	4.07	1.18	7.70	5.48	4.81	2.03	7.58	5.19	7.83
AVERAGE	2.60	6.18	5.67	4.41	1.06	7.82	5.49	4.72	2.05	8.15	4.76	8.19
St. Deviation	0.05	0.13	0.26	0.16	0.04	0.22	0.08	0.11	0.06	0.35	0.21	0.34
2 Σ of Mean	0.02	0.06	0.12	0.07	0.02	0.10	0.04	0.05	0.03	0.16	0.09	0.15
% St. Deviation	2.09	2.14	4.56	3.69	3.89	2.84	1.52	2.42	3.14	4.26	4.38	4.09

APPENDIX B.3.7:

Trace element concentrations obtained from ICP-MS analysis of individual apatite phenocrysts from within the Sprout Brook K-bentonite layer CL# 4(c) from Cobleskill, New York. Since individual crystal weights could not be measured, values shown have no units. Average, standard deviation, 2 sigma standard error of the mean, and percent standard deviation values are shown below each analyte used in further analyses

Sample Name	P	Ca	Ca/P*	Sr	Y	La	Ce	Pr	Nd	Sm	Eu
CL# 4(c).01	5407.98	10884.38	0.95	4.87	61.75	17.62	51.85	9.04	52.83	17.32	0.65
CL# 4(c).02	5888.13	11616.36	0.93	4.98	73.18	18.16	54.61	9.47	53.75	18.39	0.77
CL# 4(c).03	3204.95	6656.51	0.98	2.60	39.36	9.90	29.74	5.23	29.98	10.30	0.41
		Average		4.15	58.09	15.23	45.40	7.91	45.52	15.34	0.61
		St. Deviation		1.35	17.21	4.62	13.63	2.34	13.47	4.39	0.18
		2 Σ of Mean		1.55	19.87	5.33	15.74	2.70	15.55	5.07	0.21
		% St. Deviation		32.42	29.62	30.33	30.03	29.53	29.59	28.63	29.79

Sample Name	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Pb	Th	U
CL# 4(c).01	19.41	2.92	14.51	2.36	3.76	0.42	1.79	0.20	-0.81	0.72	0.58
CL# 4(c).02	22.53	3.34	17.37	2.92	4.96	0.50	2.11	0.26	-0.38	0.50	0.47
CL# 4(c).03	12.76	1.84	9.47	1.58	2.53	0.25	1.11	0.12	-0.14	0.32	0.24
Average	18.23	2.70	13.78	2.29	3.75	0.39	1.67	0.19	-0.44	0.51	0.43
St. Deviation	4.99	0.77	4.00	0.67	1.21	0.12	0.51	0.07	0.34	0.20	0.17
2 Σ of Mean	5.76	0.89	4.62	0.78	1.40	0.14	0.59	0.08	0.39	0.23	0.20
% St. Deviation	27.36	28.53	29.04	29.40	32.32	31.72	30.48	34.21	-76.92	38.24	40.04

APPENDIX B.3.8:

Percent relative standard deviation values for each element analyzed during ICP-MS analysis of individual apatite phenocrysts from within Sprout Brook K-bentonite layer CL# 4(c) from Cobleskill, New York. These percent values are generated during the 16 analytical passes, each containing 5 replicate analyses, for each individual crystal analyzed.

Sample Name	P	Ca	Sr	Y	La	Ce	Pr	Nd	Sm
CL# 4(c).01	1.69	4.40	3.99	3.87	2.74	3.85	3.06	6.54	2.71
CL# 4(c).02	2.38	2.58	0.87	2.66	1.84	0.97	1.87	1.49	1.85
CL# 4(c).03	2.16	2.32	1.04	1.02	1.58	2.11	1.36	3.68	3.33

Sample Name	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Pb	Th	U
CL# 4(c).01	3.81	3.18	1.25	2.32	2.61	2.63	2.47	3.99	2.64	4.30	5.16	3.26
CL# 4(c).02	3.23	2.82	3.32	3.69	4.08	6.14	4.37	4.16	4.74	7.35	10.03	4.64
CL# 4(c).03	1.88	3.80	2.68	1.02	5.12	7.52	2.59	5.33	2.59	25.85	5.91	4.45

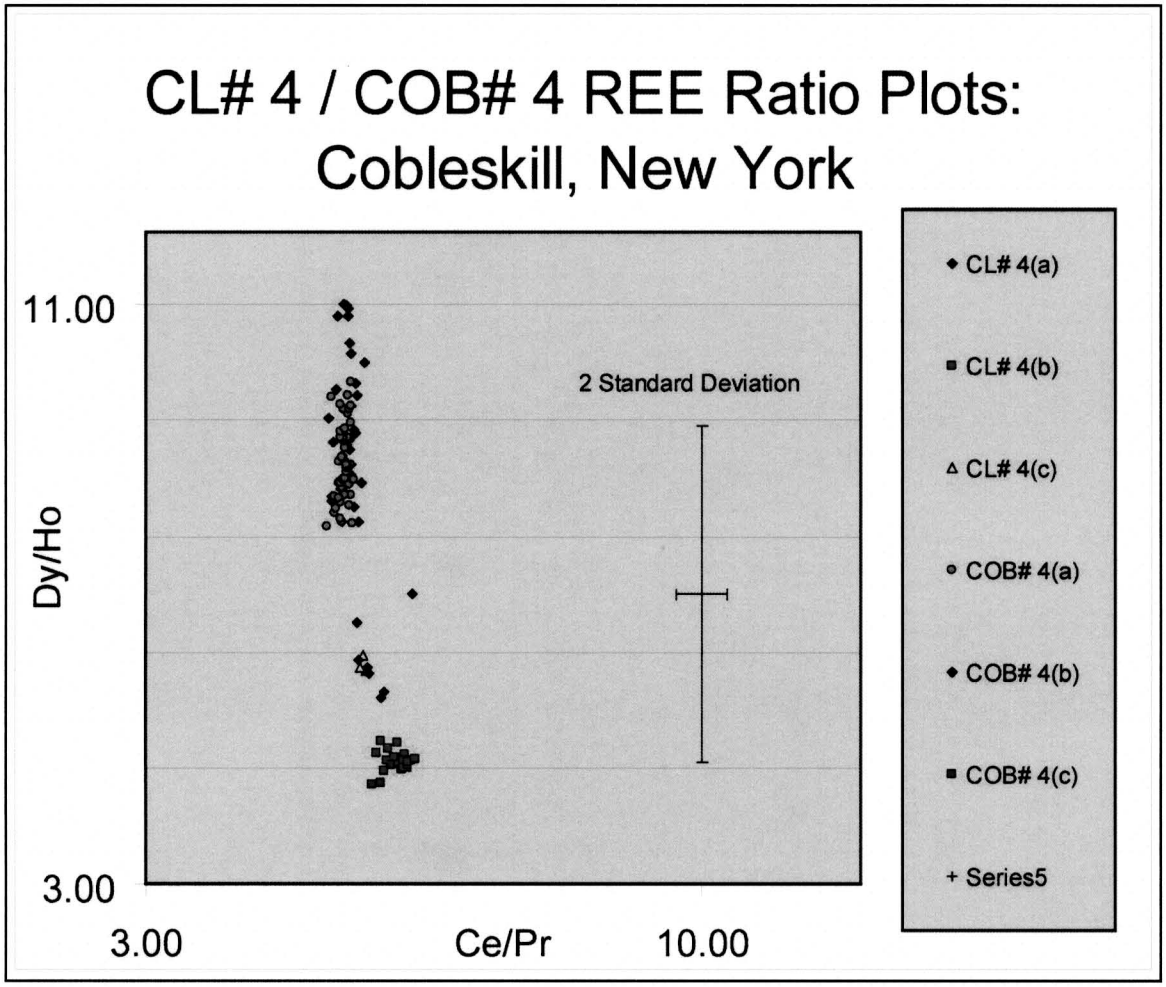
APPENDIX B.3.9:

Rare earth element ratios derived from trace element concentration values found in Appendix B.3.7. for individual apatite phenocrysts from the Sprout Brook K-bentonite layer CL# 4(c) from Locality A near Cobleskill, New York. Mean, standard deviation, 2 Sigma standard error of the mean, and percent standard deviation values for trace elements are below each ratio.

Sample Name	Ce/La	Ce/Pr	Nd/Pr	Nd/Sm	Gd/Sm	Gd/Tb	Dy/Tb	Dy/Ho	Er/Ho	Er/Tm	Yb/Tm	Yb/Lu
CL# 4(c).01	2.94	5.73	5.84	3.05	1.12	6.65	4.97	6.15	1.59	9.01	4.29	8.90
CL# 4(c).02	3.01	5.77	5.67	2.92	1.23	6.75	5.21	5.95	1.70	10.00	4.26	8.25
CL# 4(c).03	3.00	5.69	5.73	2.91	1.24	6.92	5.13	5.98	1.60	9.98	4.38	8.97
Average	2.98	5.73	5.75	2.96	1.19	6.77	5.10	6.03	1.63	9.66	4.31	8.71
St. Deviation	0.04	0.04	0.08	0.08	0.06	0.14	0.12	0.11	0.06	0.56	0.07	0.40
2 Σ of Mean	0.04	0.04	0.10	0.09	0.07	0.16	0.14	0.13	0.07	0.65	0.08	0.46
% St. Deviation	1.21	0.66	1.46	2.61	5.43	2.04	2.36	1.81	3.52	5.82	1.52	4.58

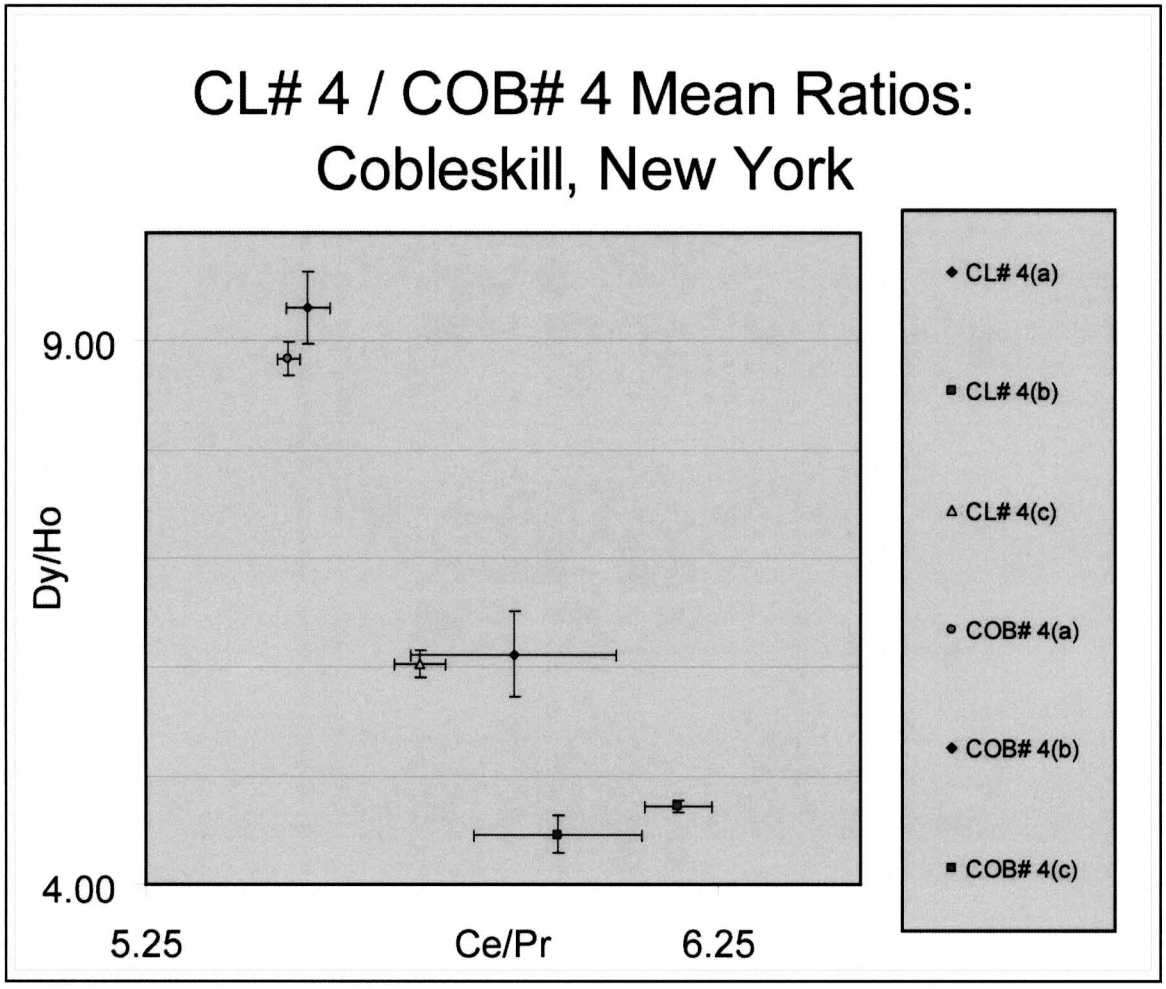
APPENDIX B.3.10:

Rare earth element ratios plots for layer CL# 4 from values listed in APPENDICES B.3.3; B.3.6; and B.3.9, in addition to values generated during identical geochemical analyses performed on grains from the same stratigraphic interval but sampled prior to this study and analyzed by Dr. George H. Shaw at Union College in Schenectady, New York. Plots generated from the K-bentonite layer COB# 4 are shown for analytical corroboration. Data populations have been subdivided and labeled based on similar geochemical ratio values. Scale and legend are given.



APPENDIX B.3.11:

Rare earth element ratios plots for layer CL# 4 from values listed in APPENDICES B.3.3; B.3.6; and B.3.9, in addition to values generated during identical geochemical analyses performed on grains from the same stratigraphic interval but sampled prior to this study and analyzed by Dr. George H. Shaw at Union College in Schenectady, New York. Plots generated from the K-bentonite layer COB# 4 are shown for analytical corroboration. Data populations have been subdivided and labeled based on similar geochemical ratio values. Error bars are 2 Sigma standard error of the mean. Scale has been exaggerated in order to show the separation of plots from one another. Scale and legend are given.



APPENDIX B.4.1a:

Trace element concentrations obtained from ICP-MS analysis of twenty seven of the fifty four individual apatite phenocrysts from within the Sprout Brook K-bentonite layer CL# 8(a) from Cobleskill, New York. Since individual crystal weights could not be measured, values shown have no units. Values for grains CL# 8(a).28 to CL# 8(a).54 are shown below each analyte used in further analyses. Mean, standard deviation, and 2 Sigma standard error of the mean and percent standard deviation values for all crystals from the subdivision CL # 8(a) are listed in Appendix B.4.

Sample Name	P	Ca	Ca/P*	Sr	Y	La	Ce	Pr	Nd	Sm	Eu
CL# 8(a).01	4182.00	8743.69	0.99	3.79	20.37	7.24	20.96	3.48	19.56	5.96	1.04
CL# 8(a).02	2405.26	5260.15	1.03	2.39	12.24	4.73	12.91	2.15	13.23	3.75	0.61
CL# 8(a).03	2236.40	4638.24	0.98	1.77	27.52	10.35	27.57	4.62	26.82	7.11	0.42
CL# 8(a).04	3046.27	6247.00	0.97	2.61	14.01	5.40	15.14	2.50	14.83	4.17	0.74
CL# 8(a).05	4757.03	10013.32	1.00	4.64	26.52	10.40	28.22	4.73	26.17	7.37	1.21
CL# 8(a).06	1209.18	2714.14	1.06	1.17	17.79	9.38	25.43	4.20	24.49	6.14	0.42
CL# 8(a).07	7758.31	16172.94	0.99	5.62	123.66	49.48	136.13	22.85	135.03	33.39	1.92
CL# 8(a).08	5711.42	12089.71	1.00	4.72	27.34	11.36	29.88	5.15	31.36	8.51	1.38
CL# 8(a).09	2196.71	4697.54	1.01	1.95	29.08	14.64	39.32	6.44	39.08	9.07	0.65
CL# 8(a).10	2702.83	5773.29	1.01	2.48	47.30	21.57	57.58	9.57	56.23	13.42	0.88
CL# 8(a).11	2350.79	5369.16	1.08	1.77	25.83	14.69	37.20	6.16	36.64	8.74	0.57
CL# 8(a).12	5648.38	11719.93	0.98	5.02	34.25	14.22	38.54	6.29	36.43	10.22	1.58
CL# 8(a).13	1389.66	2986.81	1.02	1.14	23.96	9.48	25.61	4.38	24.94	6.27	0.37
CL# 8(a).14	9341.84	19964.99	1.01	8.07	54.80	18.38	49.65	8.26	47.48	12.73	2.18
CL# 8(a).15	465.74	986.91	1.00	-0.36	4.68	2.06	5.94	0.96	5.62	1.59	0.19
CL# 8(a).16	7634.61	15619.22	0.97	5.30	33.88	18.20	39.28	6.57	39.77	19.34	1.55
CL# 8(a).17	6203.78	12631.97	0.96	5.19	36.50	14.34	39.30	6.47	37.62	10.64	1.57
CL# 8(a).18	1505.41	3144.59	0.99	0.92	19.91	9.96	26.90	4.43	25.60	6.40	0.45
CL# 8(a).19	1899.97	3884.07	0.97	1.22	23.19	9.80	26.40	4.43	26.37	6.84	0.53
CL# 8(a).20	2377.57	4696.21	0.93	0.95	27.10	14.08	38.37	6.19	35.48	8.69	0.57
CL# 8(a).21	4770.09	9964.18	0.99	4.09	60.44	31.95	84.26	14.14	82.77	20.01	1.49
CL# 8(a).22	2222.08	4468.75	0.95	2.74	13.76	9.30	24.88	4.01	22.32	5.38	0.44
CL# 8(a).23	5934.76	11958.78	0.95	5.08	80.42	23.32	68.88	11.49	65.44	19.50	0.94
CL# 8(a).24	2663.27	5353.95	0.95	2.13	16.33	6.70	18.08	2.98	17.38	4.66	0.71
CL# 8(a).25	2627.55	5509.36	0.99	1.98	32.32	14.23	38.95	6.60	35.75	9.68	0.59
CL# 8(a).26	3233.51	7181.28	1.05	3.50	16.46	7.04	17.94	3.04	16.90	4.61	0.72
CL# 8(a).27	3165.62	6751.67	1.01	2.61	55.05	26.95	70.57	11.76	68.54	16.89	1.06

APPENDIX B.4.1a continued

Sample Name	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Pb	Th	U
CL# 8(a).01	6.83	0.95	4.76	0.94	1.60	0.21	1.08	0.15	-0.16	1.39	0.21
CL# 8(a).02	4.32	0.60	2.90	0.59	1.01	0.14	0.67	0.09	5.16	0.86	0.11
CL# 8(a).03	8.04	1.08	5.89	1.23	2.57	0.33	1.59	0.21	-3.19	0.44	0.12
CL# 8(a).04	4.65	0.64	3.24	0.74	1.19	0.16	0.75	0.11	-1.23	0.80	0.12
CL# 8(a).05	8.28	1.14	5.73	1.12	2.27	0.32	1.49	0.22	-1.26	1.88	0.30
CL# 8(a).06	6.65	0.86	4.33	0.89	1.71	0.20	0.97	0.12	-3.32	0.98	0.09
CL# 8(a).07	37.31	5.11	27.75	5.70	11.60	1.48	7.13	0.85	-3.33	31.12	0.87
CL# 8(a).08	10.39	1.32	6.56	1.26	2.79	0.29	1.47	0.19	-1.46	2.20	0.30
CL# 8(a).09	10.22	1.31	7.38	1.36	2.65	0.32	1.61	0.18	-2.22	1.72	0.21
CL# 8(a).10	14.74	1.93	9.84	1.98	3.99	0.49	2.30	0.28	-2.35	2.14	0.24
CL# 8(a).11	9.66	1.19	6.10	1.28	2.47	0.28	1.34	0.16	-0.83	0.95	0.09
CL# 8(a).12	11.81	1.56	7.89	1.51	2.93	0.38	1.95	0.26	-0.07	2.09	0.35
CL# 8(a).13	6.99	0.93	5.15	1.09	2.21	0.29	1.35	0.16	-0.14	0.54	0.08
CL# 8(a).14	14.75	2.00	11.05	2.27	4.42	0.62	3.21	0.41	6.93	1.25	0.43
CL# 8(a).15	1.73	0.23	1.08	0.21	0.39	0.05	0.21	0.03	-0.62	0.35	0.04
CL# 8(a).16	11.12	1.46	7.59	1.59	3.17	0.41	2.13	0.31	-0.59	1.98	0.39
CL# 8(a).17	12.38	1.67	8.05	1.57	3.16	0.41	2.05	0.28	-0.75	3.04	0.41
CL# 8(a).18	6.60	0.87	4.50	0.94	1.81	0.21	1.16	0.14	-3.06	0.65	0.10
CL# 8(a).19	7.50	1.01	5.36	1.13	2.25	0.27	1.39	0.17	-0.95	0.82	0.13
CL# 8(a).20	9.51	1.23	6.32	1.26	2.62	0.31	1.39	0.18	-0.12	0.74	0.11
CL# 8(a).21	21.93	2.80	15.01	2.99	5.86	0.71	3.42	0.41	-0.27	3.15	0.44
CL# 8(a).22	5.49	0.71	3.68	0.67	1.39	0.17	0.81	0.10	-6.85	1.19	0.16
CL# 8(a).23	23.87	3.19	17.04	3.62	7.43	0.93	4.51	0.55	38.31	1.83	0.30
CL# 8(a).24	5.47	0.73	3.66	0.72	1.43	0.18	0.94	0.12	18.65	1.10	0.15
CL# 8(a).25	10.16	1.38	7.39	1.53	3.02	0.38	1.88	0.22	-5.69	1.49	0.20
CL# 8(a).26	5.21	0.70	3.75	0.85	1.51	0.20	1.05	0.13	10.66	0.64	0.18
CL# 8(a).27	19.10	2.36	12.14	2.44	4.72	0.59	2.81	0.34	28.32	2.04	0.27

APPENDIX B.4.1b:

Trace element concentrations obtained from ICP-MS analysis of twenty seven of the fifty four individual apatite phenocrysts from within the Sprout Brook K-bentonite layer CL# 8(a) from Cobleskill, New York. Since individual crystal weights could not be measured, values shown have no units. Values for grains CL# 8(a).28 to CL# 8(a).54 are shown below each analyte used in further analyses. Mean, standard deviation, and 2 Sigma standard error of the mean and percent standard deviation values for all crystals from the subdivision CL # 8(a) are listed in Appendix B.4.4

Sample Name	P	Ca	Ca/P*	Sr	Y	La	Ce	Pr	Nd	Sm	Eu
CL# 8(a).28	5471.47	11072.84	0.96	4.51	69.84	26.18	71.92	12.23	72.26	17.75	0.95
CL# 8(a).29	1230.33	2278.99	0.88	0.86	5.47	1.80	5.22	0.89	5.32	1.65	0.28
CL# 8(a).30	2141.43	4555.88	1.01	1.71	45.72	22.84	59.04	10.10	61.62	13.88	0.79
CL# 8(a).31	1839.75	3810.59	0.98	1.51	41.52	19.28	52.11	8.91	53.07	12.76	0.72
CL# 8(a).32	2579.74	5191.37	0.95	2.30	42.50	12.36	34.18	5.79	34.95	9.36	0.54
CL# 8(a).33	3566.07	7408.48	0.98	2.76	58.90	27.95	74.90	12.45	76.66	17.13	1.06
CL# 8(a).34	1687.59	3321.88	0.93	1.12	19.42	7.39	19.81	3.36	20.33	5.05	0.28
CL# 8(a).35	3034.03	6036.69	0.94	2.25	40.43	19.32	51.35	8.56	48.99	11.91	0.68
CL# 8(a).36	2790.87	5775.00	0.98	2.06	12.44	4.97	13.87	2.28	13.31	3.69	0.62
CL# 8(a).37	2433.78	5082.33	0.99	1.99	11.31	4.55	12.18	1.99	12.00	3.48	0.61
CL# 8(a).38	3948.19	8088.91	0.97	3.41	23.95	10.89	28.25	4.65	26.55	7.14	1.07
CL# 8(a).39	2085.52	4382.27	0.99	1.94	24.98	9.94	25.92	4.40	26.86	6.69	0.44
CL# 8(a).40	2281.90	4760.47	0.99	2.40	16.00	6.60	17.61	3.00	17.69	4.59	0.78
CL# 8(a).41	4503.17	9553.55	1.00	3.53	23.50	10.22	26.95	4.51	27.71	7.32	1.12
CL# 8(a).42	2768.24	5746.81	0.98	2.76	13.33	5.48	14.89	2.54	15.46	4.52	0.74
CL# 8(a).43	2270.82	4646.12	0.97	2.05	28.96	12.71	33.67	5.57	31.83	8.03	0.63
CL# 8(a).44	2802.83	6006.86	1.01	2.58	37.94	20.32	53.13	8.80	50.75	12.44	0.90
CL# 8(a).45	4077.07	8814.99	1.02	7.05	38.63	13.94	39.67	6.69	39.10	13.33	2.24
CL# 8(a).46	4477.98	9380.04	0.99	4.44	37.98	17.12	49.45	8.72	50.62	15.65	0.88
CL# 8(a).47	1234.46	2524.32	0.97	1.03	6.93	2.63	7.07	1.21	7.64	2.16	0.35
CL# 8(a).48	4337.50	9200.32	1.00	6.56	26.35	20.41	50.73	7.92	44.31	9.12	1.21
CL# 8(a).49	1165.04	2316.73	0.94	0.95	11.89	6.63	17.72	2.90	17.41	4.12	0.34
CL# 8(a).50	2053.53	4388.60	1.01	3.52	19.81	10.38	26.64	4.54	26.43	6.33	0.49
CL# 8(a).51	4152.99	8592.45	0.98	3.37	18.83	7.74	20.98	3.53	21.33	5.81	0.96
CL# 8(a).52	1836.29	3775.06	0.97	1.85	18.57	7.98	21.15	3.67	21.56	5.54	0.38
CL# 8(a).53	4884.89	9970.50	0.97	4.34	22.10	9.11	23.64	3.90	22.93	6.56	1.11
CL# 8(a).54	4411.74	9313.57	1.00	4.13	19.32	8.62	22.17	3.77	22.70	6.08	0.93

APPENDIX B.4.1b continued

Sample Name	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Pb	Th	U
CL# 8(a).28	19.98	2.75	14.99	3.19	6.70	0.83	4.11	0.54	-5.23	1.29	0.33
CL# 8(a).29	1.90	0.28	1.38	0.26	0.47	0.06	0.29	0.04	-7.07	0.39	0.04
CL# 8(a).30	15.14	1.96	10.65	2.13	4.17	0.55	2.36	0.30	-7.29	2.29	0.25
CL# 8(a).31	13.03	1.75	9.69	1.88	3.75	0.46	2.10	0.26	-5.89	1.77	0.22
CL# 8(a).32	10.82	1.59	8.75	1.87	4.10	0.49	2.60	0.31	-5.85	0.47	0.22
CL# 8(a).33	18.06	2.39	12.54	2.52	5.20	0.61	2.79	0.37	-6.40	2.20	0.25
CL# 8(a).34	5.73	0.78	4.38	0.89	1.90	0.23	1.17	0.16	-6.47	0.31	0.08
CL# 8(a).35	12.93	1.72	9.27	1.82	3.63	0.46	2.01	0.24	-6.35	1.59	0.19
CL# 8(a).36	4.59	0.63	3.06	0.61	1.05	0.14	0.73	0.09	-3.55	1.08	0.11
CL# 8(a).37	4.18	0.54	2.74	0.50	1.05	0.11	0.56	0.08	-1.93	0.84	0.09
CL# 8(a).38	8.53	1.10	5.32	1.07	2.27	0.29	1.41	0.18	-3.70	1.23	0.21
CL# 8(a).39	7.45	0.99	5.35	1.16	2.41	0.30	1.52	0.20	-0.06	0.58	0.14
CL# 8(a).40	5.23	0.70	3.73	0.84	1.57	0.20	0.98	0.14	0.57	0.71	0.14
CL# 8(a).41	8.29	1.10	5.49	1.07	2.13	0.27	1.37	0.19	-0.03	1.50	0.25
CL# 8(a).42	5.84	0.70	3.31	0.64	1.23	0.15	0.71	0.10	0.95	1.02	0.12
CL# 8(a).43	8.37	1.09	5.65	1.16	2.21	0.28	1.31	0.17	-0.06	1.91	0.17
CL# 8(a).44	13.29	1.81	9.16	1.89	3.50	0.46	2.08	0.26	0.00	1.98	0.23
CL# 8(a).45	15.26	2.06	9.86	1.86	3.47	0.47	2.46	0.34	23.36	12.63	0.61
CL# 8(a).46	16.98	2.02	9.32	1.67	2.94	0.36	1.73	0.23	0.82	1.64	0.33
CL# 8(a).47	2.52	0.31	1.63	0.31	0.61	0.08	0.46	0.06	-0.26	1.02	0.09
CL# 8(a).48	9.55	1.16	5.99	1.17	2.44	0.29	1.51	0.20	-0.49	1.30	0.26
CL# 8(a).49	4.71	0.58	2.98	0.57	1.07	0.17	0.61	0.09	-0.19	0.73	0.05
CL# 8(a).50	7.10	0.87	4.43	0.86	1.73	0.20	1.04	0.11	3.57	0.75	0.09
CL# 8(a).51	6.91	0.89	4.42	0.88	1.68	0.21	1.09	0.14	-0.54	1.10	0.15
CL# 8(a).52	6.15	0.80	3.96	0.85	1.69	0.21	1.08	0.14	0.24	0.45	0.09
CL# 8(a).53	7.71	1.00	5.03	0.97	1.86	0.24	1.25	0.16	1.75	1.43	0.18
CL# 8(a).54	6.76	0.90	4.65	0.90	1.83	0.23	1.11	0.15	1.63	1.67	0.23

APPENDIX B.4.2a:

Percent relative standard deviation values for each element analyzed during ICP-MS analysis of individual apatite phenocrysts CL# 8(a).01 to CL# 8(a).27 from within Sprout Brook K-bentonite layer CL# 8(a) from Cobleskill, New York. These percent values are generated during the 16 analytical passes, each containing 5 replicate analyses, for each individual crystal analyzed.

Sample Name	P	Ca	Sr	Y	La	Ce	Pr	Nd	Sm
CL# 8(a).01	1.85	3.25	4.96	4.21	3.19	2.85	3.79	3.59	2.47
CL# 8(a).02	5.52	4.75	1.74	3.59	2.57	4.58	3.25	8.16	7.23
CL# 8(a).03	5.06	2.60	2.25	1.69	1.79	2.13	2.87	3.94	3.48
CL# 8(a).04	2.36	3.70	2.40	6.45	2.32	2.60	1.13	6.91	3.57
CL# 8(a).05	2.67	4.18	2.11	3.07	5.33	1.50	3.13	5.13	2.74
CL# 8(a).06	1.21	8.36	3.98	1.32	1.53	1.61	2.86	3.22	2.67
CL# 8(a).07	1.84	4.04	1.79	1.17	1.23	1.53	1.57	3.45	2.36
CL# 8(a).08	0.91	1.76	1.59	1.80	1.74	1.17	2.37	3.72	1.92
CL# 8(a).09	2.33	2.19	2.34	4.39	3.29	5.87	2.60	10.54	4.79
CL# 8(a).10	3.14	2.39	1.69	18.50	1.85	2.17	1.78	4.12	2.46
CL# 8(a).11	3.61	1.68	1.60	1.57	6.85	1.94	2.08	5.53	3.43
CL# 8(a).12	2.77	4.49	2.91	4.40	3.16	1.03	2.57	2.57	3.80
CL# 8(a).13	3.29	1.18	2.79	2.14	1.48	0.90	1.62	3.07	3.63
CL# 8(a).14	1.95	2.37	2.77	3.84	2.85	1.41	4.56	5.16	0.88
CL# 8(a).15	3.15	15.61	6.27	5.39	2.53	1.98	1.87	6.86	7.36
CL# 8(a).16	3.32	2.69	1.06	4.39	39.79	2.92	1.16	2.31	105.46
CL# 8(a).17	2.34	3.13	2.25	4.64	1.22	1.59	1.73	2.06	2.17
CL# 8(a).18	2.31	4.81	7.31	3.43	2.77	2.13	3.36	2.71	2.35
CL# 8(a).19	3.53	3.32	4.43	3.16	3.00	2.06	3.83	4.14	4.79
CL# 8(a).20	3.03	2.96	5.98	1.90	2.56	2.26	1.77	3.38	3.04
CL# 8(a).21	5.08	2.72	2.06	2.35	0.86	2.24	2.19	3.37	2.59
CL# 8(a).22	4.34	9.46	8.40	2.16	2.89	5.19	1.77	6.55	2.99
CL# 8(a).23	4.18	2.71	1.95	4.88	2.16	2.48	2.80	2.74	2.24
CL# 8(a).24	6.57	2.32	2.55	3.16	3.75	3.91	2.88	3.53	5.39
CL# 8(a).25	2.87	7.30	3.68	3.01	1.84	2.67	0.95	2.92	2.86
CL# 8(a).26	4.03	4.20	2.47	2.43	3.66	2.33	5.18	7.06	2.85
CL# 8(a).27	5.44	6.82	4.39	14.98	1.99	3.92	3.19	4.15	4.10

APPENDIX B.4.2a continued

Sample Name	P	Ca	Sr	Y	La	Ce	Pr	Nd	Sm
CL# 8(a).28	3.05	2.25	1.12	3.85	4.10	1.60	2.54	4.67	4.32
CL# 8(a).29	8.53	13.86	3.90	3.36	5.74	5.98	7.30	4.61	5.82
CL# 8(a).30	3.43	5.33	2.19	1.70	3.36	2.10	2.28	3.09	2.20
CL# 8(a).31	8.48	6.02	3.50	1.96	1.61	1.67	1.17	0.97	2.19
CL# 8(a).32	2.07	3.59	4.05	4.94	4.92	2.93	3.13	7.08	4.18
CL# 8(a).33	1.44	1.91	2.75	14.45	2.31	1.17	1.81	19.28	1.14
CL# 8(a).34	3.15	3.96	2.89	3.72	1.18	2.85	2.55	5.80	5.89
CL# 8(a).35	1.46	3.03	1.53	2.97	4.40	1.76	1.13	5.19	1.23
CL# 8(a).36	1.91	2.29	2.26	5.08	2.42	8.08	2.76	7.53	4.94
CL# 8(a).37	3.39	4.09	2.35	1.59	4.40	1.73	3.57	7.37	4.57
CL# 8(a).38	0.63	1.91	1.03	4.08	2.09	3.18	3.24	3.32	2.50
CL# 8(a).39	0.93	1.82	0.96	2.46	2.75	2.07	2.09	2.38	3.93
CL# 8(a).40	1.65	2.06	4.59	1.17	3.85	2.60	2.22	3.57	5.11
CL# 8(a).41	2.71	1.33	0.73	1.88	2.32	1.67	1.58	4.66	2.85
CL# 8(a).42	1.89	2.14	2.03	2.09	2.84	1.80	2.91	10.70	2.63
CL# 8(a).43	1.92	3.15	2.17	42.72	1.49	2.87	1.41	3.61	2.00
CL# 8(a).44	1.99	2.54	1.23	2.87	2.50	0.87	2.22	3.60	2.44
CL# 8(a).45	2.57	1.36	1.74	0.87	1.84	1.66	1.79	3.69	2.75
CL# 8(a).46	1.28	1.08	1.59	1.49	1.22	1.39	3.03	1.73	4.55
CL# 8(a).47	2.57	3.98	2.30	5.65	2.73	2.62	3.08	4.27	9.76
CL# 8(a).48	2.12	0.82	0.95	1.44	1.75	1.14	2.05	3.49	2.73
CL# 8(a).49	2.67	2.37	3.04	3.93	2.71	3.88	1.80	4.87	6.35
CL# 8(a).50	3.26	2.95	114.38	5.86	1.76	1.30	2.93	3.91	4.19
CL# 8(a).51	1.23	2.18	1.43	3.24	1.21	1.37	2.88	3.96	2.99
CL# 8(a).52	3.05	1.34	1.63	2.27	3.46	1.88	5.09	7.13	3.90
CL# 8(a).53	2.71	3.08	0.63	2.48	10.67	4.09	1.76	3.93	2.72
CL# 8(a).54	2.26	1.03	1.73	4.69	2.19	4.89	1.30	5.00	3.22

APPENDIX B.4.2b:

Percent relative standard deviation values for each element analyzed during ICP-MS analysis of individual apatite phenocrysts CL# 8(a).28 to CL# 8(a).54 from within Sprout Brook K-bentonite layer CL# 8(a) from Cobleskill, New York. These percent values are generated during the 16 analytical passes, each containing 5 replicate analyses, for each individual crystal analyzed.

Sample Name	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Pb	Th	U
CL# 8(a).01	2.41	3.00	4.23	3.46	5.51	5.87	9.14	5.57	3.66	21.75	8.93	44.94
CL# 8(a).02	6.71	2.63	4.07	5.51	3.53	8.37	13.73	8.60	7.53	3.89	7.37	6.46
CL# 8(a).03	4.71	3.36	3.21	3.67	2.93	3.04	2.48	3.71	6.07	2.83	7.01	8.14
CL# 8(a).04	2.10	2.91	2.99	5.15	17.36	7.05	3.33	7.67	1.94	3.49	9.49	7.57
CL# 8(a).05	2.25	2.27	4.16	3.48	3.68	7.68	8.92	6.22	9.03	3.12	7.77	3.58
CL# 8(a).06	5.32	4.32	2.59	3.59	9.82	8.83	6.68	13.58	6.35	2.31	11.69	31.10
CL# 8(a).07	3.51	0.85	1.88	2.27	0.42	2.62	2.10	2.15	1.83	3.50	203.47	4.57
CL# 8(a).08	4.17	3.66	2.72	6.28	3.26	13.16	6.87	4.67	4.23	4.30	13.26	1.98
CL# 8(a).09	2.55	4.76	1.31	14.64	2.51	2.86	2.93	5.99	6.11	6.03	15.50	10.81
CL# 8(a).10	2.97	1.09	5.35	2.87	2.05	4.02	4.52	3.74	4.76	4.22	5.06	3.49
CL# 8(a).11	1.86	2.08	2.81	6.27	3.31	7.99	2.25	13.74	9.41	15.04	5.73	4.72
CL# 8(a).12	1.37	6.88	1.41	3.12	1.94	2.87	3.10	2.54	2.83	115.20	3.82	24.99
CL# 8(a).13	2.77	2.90	2.96	6.80	6.86	8.65	2.68	5.64	6.95	42.36	4.81	14.21
CL# 8(a).14	2.77	6.14	4.15	3.84	7.04	2.78	5.76	11.42	3.60	3.05	7.07	3.81
CL# 8(a).15	49.08	5.08	6.89	3.14	6.49	6.11	10.22	8.30	18.29	8.11	10.86	16.47
CL# 8(a).16	3.49	2.03	2.13	2.08	5.45	2.22	6.10	7.37	9.34	4.20	2.10	46.88
CL# 8(a).17	5.25	2.29	3.39	2.23	2.34	5.69	8.78	5.35	5.68	2.93	2.40	8.42
CL# 8(a).18	11.92	1.09	5.06	5.51	3.98	7.36	3.18	26.29	21.75	4.32	5.60	12.78
CL# 8(a).19	2.82	4.54	1.70	2.81	3.29	2.64	2.83	4.72	4.06	2.74	6.66	5.52
CL# 8(a).20	2.16	4.78	1.79	2.50	3.05	1.87	4.30	6.39	4.23	16.90	12.45	7.21
CL# 8(a).21	4.42	2.85	2.74	6.25	3.27	2.79	3.88	8.14	3.53	18.37	4.42	8.76
CL# 8(a).22	5.51	5.66	2.31	5.18	4.09	3.42	7.22	8.59	5.93	1.56	2.14	7.46
CL# 8(a).23	3.75	2.81	3.90	3.44	2.60	2.35	2.98	3.31	3.68	5.50	2.63	8.76
CL# 8(a).24	3.04	5.24	4.33	5.95	4.48	9.00	4.48	8.01	4.20	4.19	5.63	9.09
CL# 8(a).25	5.09	3.59	2.39	5.14	4.64	5.82	3.42	3.73	3.60	3.00	5.28	1.19
CL# 8(a).26	6.16	7.09	4.75	1.84	18.13	4.68	6.96	3.28	4.18	4.45	33.50	10.97
CL# 8(a).27	4.42	4.72	4.69	3.90	3.89	2.57	3.33	4.14	2.62	3.86	29.48	7.96

APPENDIX B.4.2b continued

Sample Name	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Pb	Th	U
CL# 8(a).28	4.88	4.19	0.77	5.11	2.26	1.27	2.46	3.91	5.38	3.03	5.93	4.09
CL# 8(a).29	6.72	6.44	5.55	10.62	5.92	9.42	10.17	13.85	10.97	3.60	11.94	27.63
CL# 8(a).30	2.06	1.84	2.28	2.31	3.78	2.63	11.62	5.88	4.08	4.47	4.33	7.42
CL# 8(a).31	2.51	6.09	2.35	3.19	2.17	4.48	1.34	3.27	4.25	4.49	4.61	9.56
CL# 8(a).32	2.69	4.14	2.79	2.23	4.14	11.80	5.80	22.85	6.21	3.53	9.19	9.85
CL# 8(a).33	3.48	1.70	3.03	5.46	3.48	4.63	4.03	2.54	3.19	2.28	4.44	6.01
CL# 8(a).34	7.44	2.47	1.48	4.01	2.54	4.78	3.29	4.34	3.01	0.87	18.74	13.20
CL# 8(a).35	2.36	4.52	1.37	4.06	3.35	8.93	3.04	4.14	6.85	2.64	5.05	7.44
CL# 8(a).36	1.43	2.98	7.77	3.95	13.21	4.78	15.20	5.00	11.80	3.34	15.05	16.45
CL# 8(a).37	2.96	2.99	4.28	5.71	5.14	7.53	3.47	9.48	9.99	5.25	8.59	10.77
CL# 8(a).38	2.82	1.98	3.92	3.51	3.15	4.34	4.57	16.99	6.76	1.10	5.49	5.01
CL# 8(a).39	2.36	5.39	0.84	4.19	2.94	2.49	5.78	3.38	2.83	54.45	8.60	6.96
CL# 8(a).40	5.37	5.13	1.58	3.27	25.07	6.00	10.18	6.21	17.98	6.64	4.97	12.11
CL# 8(a).41	2.45	0.16	2.25	2.00	2.14	8.30	5.53	5.39	4.74	43.92	4.55	7.84
CL# 8(a).42	4.92	13.93	2.82	4.20	4.89	5.34	4.56	6.48	5.95	8.21	2.26	8.65
CL# 8(a).43	6.16	3.05	2.76	4.63	8.16	6.10	14.21	6.85	5.42	66.96	11.32	7.83
CL# 8(a).44	2.04	1.35	2.69	4.82	3.71	6.03	5.95	9.43	7.39	1499.29	2.72	5.85
CL# 8(a).45	1.70	3.20	1.68	3.09	3.06	3.21	2.50	8.02	2.44	2.44	1.60	5.25
CL# 8(a).46	3.71	3.72	2.83	2.40	2.99	4.49	3.07	3.24	4.32	6.98	3.65	5.58
CL# 8(a).47	1.00	8.51	2.06	6.65	3.09	9.55	5.00	22.79	27.86	14.80	3.56	9.62
CL# 8(a).48	2.95	3.97	0.45	2.42	3.06	5.31	4.27	6.99	3.90	4.60	3.50	8.13
CL# 8(a).49	4.20	10.47	3.36	4.52	6.24	3.71	51.78	10.05	14.06	34.83	5.79	7.44
CL# 8(a).50	6.01	5.28	2.86	10.24	3.56	4.63	7.98	1.81	6.87	3.65	3.31	21.44
CL# 8(a).51	2.65	6.64	2.12	4.54	3.61	6.93	5.85	5.78	4.76	6.42	4.04	3.76
CL# 8(a).52	3.59	5.39	2.69	2.23	3.87	5.24	4.01	9.01	9.17	15.41	8.76	14.73
CL# 8(a).53	3.09	3.07	3.09	4.54	4.14	8.21	7.59	3.42	10.23	4.34	5.24	11.35
CL# 8(a).54	2.97	1.19	1.82	7.12	3.25	7.43	5.78	2.46	7.37	3.47	5.42	9.10

APPENDIX B.4.3a:

Rare earth element ratios derived from trace element concentration values found in Appendix A.15.1. for twenty seven of the fifty four individual apatite phenocrysts from the Sprout Brook K-bentonite layer CL# 8(a) from Locality A, near Cobleskill, New York. Ratio values for CL# 8(a).01 to CL# 8(a).27 are shown below each analyte used in further analyses. Mean, standard deviation, and 2 Sigma standard error of the mean and percent standard deviation values for all crystals from the subdivision CL # 8(a) are listed in Appendix B.4.4.

Sample Name	Ce/La	Ce/Pr	Nd/Pr	Nd/Sm	Gd/Sm	Gd/Tb	Dy/Tb	Dy/Ho	Er/Ho	Er/Tm	Yb/Tm	Yb/Lu
CL# 8(a).01	2.90	6.02	5.62	3.28	1.15	7.20	5.02	5.06	1.70	7.47	5.07	7.45
CL# 8(a).02	2.73	6.00	6.15	3.53	1.15	7.18	4.81	4.94	1.72	7.26	4.83	7.18
CL# 8(a).03	2.66	5.97	5.81	3.77	1.13	7.43	5.44	4.77	2.09	7.81	4.83	7.70
CL# 8(a).04	2.80	6.05	5.93	3.56	1.11	7.24	5.05	4.38	1.61	7.58	4.78	7.07
CL# 8(a).05	2.71	5.96	5.53	3.55	1.12	7.25	5.01	5.12	2.03	7.10	4.66	6.69
CL# 8(a).06	2.71	6.05	5.82	3.99	1.08	7.77	5.06	4.87	1.92	8.72	4.94	8.36
CL# 8(a).07	2.75	5.96	5.91	4.04	1.12	7.30	5.43	4.87	2.03	7.83	4.82	8.37
CL# 8(a).08	2.63	5.80	6.09	3.68	1.22	7.89	4.98	5.21	2.22	9.65	5.09	7.64
CL# 8(a).09	2.69	6.11	6.07	4.31	1.13	7.80	5.63	5.44	1.95	8.17	4.97	8.92
CL# 8(a).10	2.67	6.02	5.88	4.19	1.10	7.64	5.10	4.97	2.01	8.10	4.68	8.34
CL# 8(a).11	2.53	6.04	5.95	4.19	1.11	8.15	5.14	4.78	1.93	8.74	4.77	8.16
CL# 8(a).12	2.71	6.13	5.79	3.57	1.16	7.58	5.06	5.23	1.94	7.65	5.09	7.54
CL# 8(a).13	2.70	5.84	5.69	3.98	1.12	7.49	5.51	4.73	2.03	7.61	4.66	8.23
CL# 8(a).14	2.70	6.01	5.75	3.73	1.16	7.37	5.52	4.87	1.95	7.17	5.21	7.92
CL# 8(a).15	2.88	6.22	5.88	3.54	1.09	7.58	4.76	5.06	1.80	7.98	4.35	6.77
CL# 8(a).16	2.16	5.98	6.05	2.06	0.57	7.60	5.19	4.78	2.00	7.66	5.15	6.98
CL# 8(a).17	2.74	6.07	5.81	3.53	1.16	7.43	4.83	5.14	2.01	7.65	4.96	7.37
CL# 8(a).18	2.70	6.07	5.78	4.00	1.03	7.60	5.18	4.77	1.91	8.51	5.46	8.23
CL# 8(a).19	2.69	5.96	5.96	3.86	1.10	7.46	5.33	4.74	1.99	8.40	5.19	8.04
CL# 8(a).20	2.72	6.20	5.74	4.09	1.09	7.71	5.12	5.01	2.08	8.43	4.48	7.82
CL# 8(a).21	2.64	5.96	5.85	4.14	1.10	7.83	5.36	5.02	1.96	8.24	4.82	8.41
CL# 8(a).22	2.68	6.21	5.57	4.15	1.02	7.73	5.18	5.52	2.08	8.09	4.70	8.14
CL# 8(a).23	2.95	6.00	5.70	3.36	1.22	7.48	5.34	4.70	2.05	7.96	4.84	8.18
CL# 8(a).24	2.70	6.07	5.84	3.73	1.17	7.48	5.00	5.09	1.99	7.87	5.16	7.53
CL# 8(a).25	2.74	5.90	5.42	3.69	1.05	7.34	5.34	4.83	1.97	7.86	4.89	8.66
CL# 8(a).26	2.55	5.91	5.57	3.67	1.13	7.39	5.32	4.43	1.78	7.62	5.29	7.95
CL# 8(a).27	2.62	6.00	5.83	4.06	1.13	8.08	5.13	4.98	1.94	8.07	4.80	8.38

APPENDIX B.4.3b:

Rare earth element ratios derived from trace element concentration values found in Appendix A.15.1. for twenty seven of the fifty four individual apatite phenocrysts from the Sprout Brook K-bentonite layer CL# 8(a) from Locality A, near Cobleskill, New York. Ratio values for CL# 8(a).28 to CL# 8(a).54 are shown below each analyte used in further analyses. Mean, standard deviation, and 2 Sigma standard error of the mean and percent standard deviation values for all crystals from the subdivision CL # 8(a) are listed in Appendix B.4.4.

Sample Name	Ce/La	Ce/Pr	Nd/Pr	Nd/Sm	Gd/Sm	Gd/Tb	Dy/Tb	Dy/Ho	Er/Ho	Er/Tm	Yb/Tm	Yb/Lu
CL# 8(a).28	2.75	5.88	5.91	4.07	1.13	7.27	5.45	4.70	2.10	8.06	4.95	7.59
CL# 8(a).29	2.91	5.83	5.95	3.22	1.15	6.78	4.92	5.26	1.81	8.14	4.91	7.12
CL# 8(a).30	2.58	5.84	6.10	4.44	1.09	7.72	5.43	4.99	1.95	7.58	4.29	7.73
CL# 8(a).31	2.70	5.85	5.95	4.16	1.02	7.44	5.54	5.15	1.99	8.16	4.56	7.94
CL# 8(a).32	2.77	5.90	6.03	3.73	1.16	6.81	5.51	4.67	2.19	8.29	5.25	8.40
CL# 8(a).33	2.68	6.01	6.15	4.48	1.05	7.57	5.26	4.98	2.06	8.59	4.61	7.63
CL# 8(a).34	2.68	5.90	6.05	4.03	1.14	7.34	5.60	4.93	2.14	8.27	5.11	7.46
CL# 8(a).35	2.66	6.00	5.73	4.11	1.09	7.54	5.41	5.11	2.00	7.97	4.41	8.35
CL# 8(a).36	2.79	6.08	5.84	3.61	1.24	7.34	4.90	5.00	1.72	7.33	5.05	7.89
CL# 8(a).37	2.68	6.12	6.02	3.44	1.20	7.69	5.04	5.43	2.08	9.22	4.92	7.32
CL# 8(a).38	2.59	6.07	5.70	3.72	1.19	7.75	4.84	4.97	2.12	7.87	4.89	7.69
CL# 8(a).39	2.61	5.89	6.11	4.01	1.11	7.54	5.41	4.63	2.08	7.91	4.99	7.49
CL# 8(a).40	2.67	5.86	5.89	3.85	1.14	7.48	5.33	4.42	1.86	7.72	4.79	7.22
CL# 8(a).41	2.64	5.98	6.15	3.78	1.13	7.51	4.97	5.12	1.98	7.88	5.08	7.40
CL# 8(a).42	2.72	5.86	6.08	3.42	1.29	8.35	4.74	5.20	1.93	8.34	4.83	6.94
CL# 8(a).43	2.65	6.04	5.71	3.96	1.04	7.67	5.18	4.86	1.90	7.98	4.72	7.65
CL# 8(a).44	2.61	6.04	5.77	4.08	1.07	7.32	5.04	4.83	1.85	7.63	4.54	7.89
CL# 8(a).45	2.85	5.93	5.84	2.93	1.15	7.40	4.78	5.31	1.87	7.42	5.25	7.31
CL# 8(a).46	2.89	5.67	5.81	3.23	1.08	8.40	4.61	5.57	1.76	8.21	4.84	7.65
CL# 8(a).47	2.69	5.84	6.31	3.54	1.17	8.10	5.23	5.21	1.95	7.94	5.99	7.21
CL# 8(a).48	2.49	6.41	5.60	4.86	1.05	8.20	5.15	5.13	2.09	8.38	5.18	7.69
CL# 8(a).49	2.67	6.11	6.01	4.23	1.15	8.06	5.09	5.26	1.89	6.29	3.59	6.91
CL# 8(a).50	2.57	5.87	5.83	4.17	1.12	8.15	5.09	5.17	2.02	8.54	5.11	9.09
CL# 8(a).51	2.71	5.94	6.03	3.67	1.19	7.76	4.96	5.04	1.91	8.16	5.29	7.51
CL# 8(a).52	2.65	5.76	5.87	3.89	1.11	7.73	4.97	4.64	1.98	7.97	5.11	7.94
CL# 8(a).53	2.60	6.05	5.87	3.50	1.18	7.73	5.04	5.19	1.92	7.67	5.16	7.66
CL# 8(a).54	2.57	5.88	6.02	3.74	1.11	7.51	5.17	5.16	2.03	7.85	4.75	7.22

APPENDIX B.4.4:

Cumulative statistical values for all 54 grains selected from the K-bentonite layer CL# 8(a) from Locality A near Cobleskill, New York. Appendix B.4.4a is statistical information from trace elements values generated during ICP-MS analysis. Appendix B.4.4b is statistical information from trace element ratios generated from those values in Appendix B.4.1a and Appendix B.4.1b

APPENDIX B.4.4a

	Sr	Y	La	Ce	Pr	Nd	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Pb	Th	U
Average	2.95	30.40	13.27	35.52	5.94	34.84	9.13	0.85	10.03	1.32	6.89	1.39	2.76	0.35	1.69	0.22	0.76	2.06	0.21
St. Deviation	1.74	20.75	8.59	23.25	3.90	23.00	5.81	0.47	6.29	0.84	4.56	0.94	1.92	0.24	1.17	0.14	8.50	4.36	0.15
2 Σ of Mean	0.47	5.65	2.34	6.33	1.06	6.26	1.58	0.13	1.71	0.23	1.24	0.26	0.52	0.07	0.32	0.04	2.31	1.19	0.04
% St. Deviation	58.83	68.25	64.74	65.45	65.65	66.02	63.66	54.85	62.71	63.71	66.20	67.53	69.80	70.17	69.37	66.03	1117.16	211.79	68.99

APPENDIX B.4.4b

	Ce/La	Ce/Pr	Nd/Pr	Nd/Sm	Gd/Sm	Gd/Tb	Dy/Tb	Dy/Ho	Er/Ho	Er/Tm	Yb/Tm	Yb/Lu
AVERAGE	2.69	5.98	5.88	3.80	1.12	7.60	5.16	4.99	1.96	7.97	4.90	7.74
St. Deviation	0.12	0.13	0.18	0.43	0.09	0.33	0.24	0.26	0.12	0.53	0.34	0.54
2 Σ of Mean	0.03	0.03	0.05	0.12	0.03	0.09	0.07	0.07	0.03	0.14	0.09	0.15
% St. Deviation	4.47	2.13	3.09	11.31	8.32	4.38	4.69	5.27	6.34	6.60	7.03	6.92

APPENDIX B.4.5:

Trace element concentrations obtained from ICP-MS analysis of individual apatite phenocrysts from within the Sprout Brook K-bentonite layer CL# 8(b) from Cobleskill, New York. Since individual crystal weights could not be measured, values shown have no units. Average, standard deviation, 2 sigma standard error of the mean and percent standard deviation values are shown below each analyte used in further analyses.

Sample Name	P	Ca	Ca/P*	Sr	Y	La	Ce	Pr	Nd	Sm	Eu
CL# 8(b).01	2438.34	5606.75	1.09	2.38	23.15	8.08	27.13	4.89	28.46	11.20	0.57
CL# 8(b).02	2396.74	4852.01	0.96	1.91	20.60	7.39	24.28	4.37	25.81	9.69	0.54
CL# 8(b).03	2645.80	5823.21	1.04	3.16	18.44	10.07	30.84	5.46	33.34	10.94	0.74
CL# 8(b).04	1693.77	3521.45	0.98	1.52	11.90	6.42	19.67	3.53	20.78	7.46	0.44
CL# 8(b).05	1994.38	4083.21	0.97	1.59	11.97	6.56	20.61	3.75	21.61	7.89	0.40
CL# 8(b).06	4150.12	8443.79	0.96	3.57	24.95	13.86	44.67	7.86	46.42	16.26	0.85
CL# 8(b).07	2831.22	5749.92	0.96	2.37	17.87	9.41	29.69	5.42	30.89	11.54	0.62
CL# 8(b).08	2927.85	6042.10	0.98	2.90	17.68	8.39	27.43	5.08	30.94	10.77	0.63
CL# 8(b).09	1748.79	3609.49	0.98	1.39	16.47	5.52	17.67	3.15	19.57	6.81	0.38
CL# 8(b).10	1278.27	2580.38	0.95	0.97	12.72	4.48	14.63	2.73	16.62	6.31	0.29
CL# 8(b).11	4688.71	9690.15	0.98	4.16	30.41	16.75	51.81	9.34	56.13	19.23	1.01
CL# 8(b).12	2330.52	4894.86	0.99	2.07	17.35	7.04	22.67	4.11	23.59	8.92	0.47
CL# 8(b).13	1694.21	3493.97	0.98	1.20	13.38	4.77	15.24	2.79	17.22	6.44	0.31
CL# 8(b).14	796.55	1871.11	1.11	0.87	5.53	2.39	7.39	1.42	8.51	3.09	0.13
		Average		2.15	17.32	7.94	25.27	4.56	27.14	9.75	0.53
		St. Deviation		1.00	6.27	3.76	11.74	2.07	12.34	4.16	0.23
		2 Σ of Mean		0.54	3.35	2.01	6.27	1.11	6.60	2.22	0.12
		% St. Deviation		46.66	36.19	47.36	46.46	45.44	45.47	42.67	44.14

Sample Name	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Pb	Th	U
CL# 8(b).01	13.16	1.65	6.78	1.10	1.54	0.12	0.58	0.06	-2.51	1.10	0.19
CL# 8(b).02	11.19	1.38	6.04	0.96	1.36	0.13	0.64	0.07	-3.02	0.96	0.23
CL# 8(b).03	11.01	1.30	5.44	0.83	1.35	0.15	0.65	0.08	0.31	2.18	0.23
CL# 8(b).04	8.01	0.98	3.55	0.51	0.76	0.08	0.39	0.05	-2.80	0.99	0.18
CL# 8(b).05	8.39	0.95	3.82	0.51	0.83	0.08	0.34	0.05	-3.24	0.54	0.14
CL# 8(b).06	17.30	1.96	7.68	1.03	1.78	0.19	0.75	0.09	-2.58	1.95	0.38
CL# 8(b).07	12.22	1.45	5.80	0.80	1.24	0.15	0.60	0.07	-4.26	0.89	0.22
CL# 8(b).08	11.83	1.39	5.40	0.72	1.13	0.12	0.53	0.07	-3.42	1.32	0.27
CL# 8(b).09	7.40	1.01	4.39	0.62	0.96	0.10	0.51	0.08	-7.51	0.61	0.18
CL# 8(b).10	6.93	0.93	3.99	0.53	0.68	0.06	0.26	0.03	-5.87	1.03	0.11
CL# 8(b).11	20.68	2.30	9.69	1.30	1.96	0.21	0.87	0.12	-2.76	1.61	0.36
CL# 8(b).12	9.73	1.23	5.10	0.76	1.32	0.10	0.48	0.05	0.08	1.72	0.23
CL# 8(b).13	7.29	0.95	3.99	0.56	0.77	0.07	0.31	0.04	-0.27	0.59	0.12
CL# 8(b).14	3.26	0.41	1.72	0.25	0.31	0.03	0.13	0.02	16.95	0.11	0.06
Average	10.60	1.28	5.24	0.75	1.14	0.11	0.50	0.06	-1.49	1.11	0.21
St. Deviation	4.46	0.48	1.97	0.28	0.45	0.05	0.20	0.03	5.72	0.59	0.09
2 Σ of Mean	2.38	0.26	1.05	0.15	0.24	0.03	0.11	0.01	3.06	0.31	0.05
% St. Deviation	42.09	37.36	37.50	37.62	39.83	43.26	40.09	41.13	-382.52	52.69	42.81

APPENDIX B.4.6:

Percent relative standard deviation values for each element analyzed during ICP-MS analysis of individual apatite phenocrysts from within Sprout Brook K-bentonite layer CL# 8(b) from Cobleskill, New York. These percent values are generated during the 16 analytical passes, each containing 5 replicate analyses, for each individual crystal analyzed.

Sample Name	P	Ca	Sr	Y	La	Ce	Pr	Nd	Sm	Eu
CL# 8(b).01	3.93	3.32	2.44	3.27	2.13	2.29	1.75	3.24	1.47	4.45
CL# 8(b).02	3.71	1.85	4.50	6.54	2.35	2.37	3.14	3.21	1.43	4.67
CL# 8(b).03	3.45	2.46	1.43	3.48	1.85	2.63	2.29	4.94	10.23	4.33
CL# 8(b).04	4.88	5.01	3.89	4.59	1.48	3.16	2.56	3.91	4.34	5.18
CL# 8(b).05	4.01	3.33	1.30	2.23	2.08	1.26	1.76	5.61	4.83	4.25
CL# 8(b).06	3.42	3.88	2.41	1.14	2.68	3.23	2.55	3.69	2.87	2.46
CL# 8(b).07	4.07	8.22	1.54	2.27	3.16	3.73	2.18	7.11	3.53	4.61
CL# 8(b).08	2.52	4.99	1.16	3.63	2.22	2.04	3.01	14.05	3.27	2.77
CL# 8(b).09	3.93	7.59	5.01	1.71	3.85	3.17	4.84	2.57	3.57	5.75
CL# 8(b).10	4.11	7.49	2.15	2.23	10.06	2.74	2.47	5.86	3.47	6.66
CL# 8(b).11	2.67	3.20	3.13	4.23	1.70	2.72	1.71	5.26	2.09	3.09
CL# 8(b).12	2.70	1.65	2.12	1.59	2.06	3.76	1.00	3.83	3.38	3.17
CL# 8(b).13	5.02	4.94	4.11	2.63	4.68	3.16	1.05	9.05	4.98	5.08
CL# 8(b).14	1.65	3.23	2.72	2.87	2.01	3.72	2.10	5.04	4.88	3.97

Sample Name	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Pb	Th	U
CL# 8(b).01	9.23	3.89	5.36	26.15	18.30	3.41	27.02	9.62	5.58	4.99	5.15
CL# 8(b).02	1.58	1.44	4.52	25.52	19.47	13.97	38.35	5.24	3.66	3.49	40.89
CL# 8(b).03	2.52	1.65	3.57	4.55	3.55	6.11	5.81	14.69	31.91	3.12	9.55
CL# 8(b).04	4.13	10.96	7.39	3.92	3.78	8.32	10.18	4.54	3.09	3.55	5.22
CL# 8(b).05	2.82	2.87	5.09	3.51	5.56	18.89	12.11	5.65	1.92	7.63	7.54
CL# 8(b).06	3.58	0.65	1.22	3.93	29.09	23.62	3.08	5.20	4.78	2.16	4.30
CL# 8(b).07	4.47	2.15	4.75	1.57	6.43	15.68	8.34	15.90	7.71	4.41	5.39
CL# 8(b).08	3.13	2.36	4.65	6.21	5.90	8.97	9.93	21.25	9.07	7.32	6.14
CL# 8(b).09	4.87	2.74	4.01	4.73	16.15	12.17	14.37	26.96	4.06	6.62	5.07
CL# 8(b).10	4.37	5.79	3.32	5.29	5.66	11.91	8.02	21.85	2.64	3.45	10.72
CL# 8(b).11	2.90	1.34	13.25	2.91	4.32	5.81	5.41	8.51	7.29	4.53	7.32
CL# 8(b).12	1.03	2.39	4.43	15.04	58.31	6.34	19.53	8.21	66.87	3.41	4.45
CL# 8(b).13	4.59	4.89	1.93	4.04	9.39	11.17	8.27	12.08	13.86	7.19	25.04
CL# 8(b).14	4.03	1.18	8.09	9.68	13.01	9.16	16.60	13.01	1.04	13.60	20.50

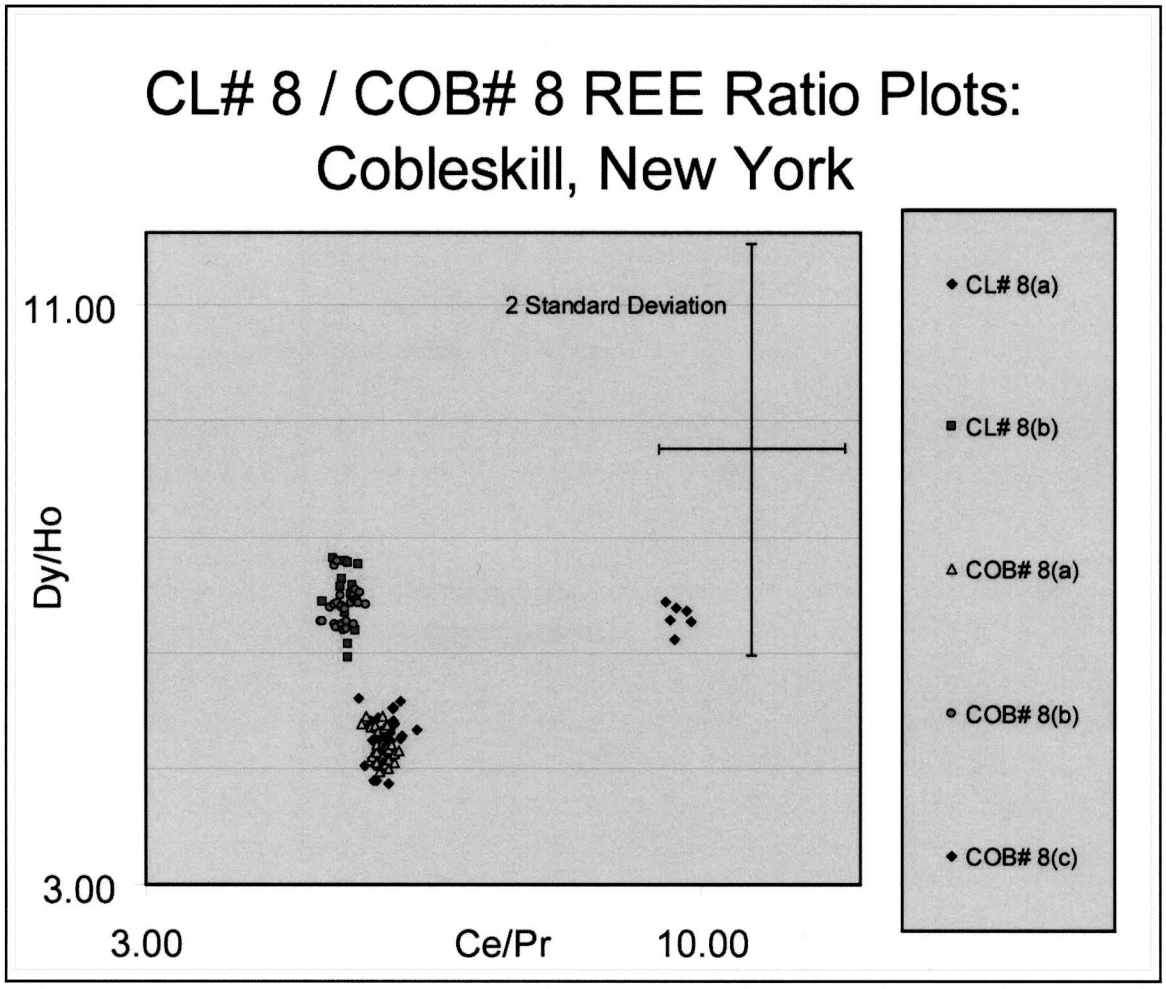
APPENDIX B.4.7:

Rare earth element ratios derived from trace element concentration values found in APPENDIX B.4.5 for individual apatite phenocrysts from the Sprout Brook K-bentonite layer CL# 8(b) from Locality A near Cobleskill, New York. Mean, standard deviation, 2 Sigma standard error of the mean, and percent standard deviation values for trace elements are below each ratio

Sample Name	Ce/La	Ce/Pr	Nd/Pr	Nd/Sm	Gd/Sm	Gd/Tb	Dy/Tb	Dy/Ho	Er/Ho	Er/Tm	Yb/Tm	Yb/Lu
CL# 8(b).01	3.36	5.55	5.82	2.54	1.18	7.97	4.11	6.14	1.39	12.34	4.67	10.01
CL# 8(b).02	3.28	5.56	5.91	2.66	1.16	8.13	4.39	6.32	1.42	10.74	5.03	9.42
CL# 8(b).03	3.06	5.65	6.11	3.05	1.01	8.48	4.19	6.51	1.62	9.18	4.38	7.77
CL# 8(b).04	3.07	5.58	5.89	2.79	1.07	8.20	3.64	7.01	1.49	9.09	4.70	7.21
CL# 8(b).05	3.14	5.50	5.77	2.74	1.06	8.81	4.02	7.46	1.63	10.06	4.07	7.36
CL# 8(b).06	3.22	5.68	5.90	2.85	1.06	8.84	3.92	7.42	1.72	9.22	3.89	8.79
CL# 8(b).07	3.15	5.48	5.70	2.68	1.06	8.45	4.01	7.21	1.55	8.46	4.05	9.04
CL# 8(b).08	3.27	5.40	6.09	2.87	1.10	8.50	3.88	7.46	1.56	9.04	4.21	7.63
CL# 8(b).09	3.20	5.60	6.21	2.87	1.09	7.31	4.34	7.12	1.55	9.31	4.99	6.74
CL# 8(b).10	3.26	5.36	6.09	2.63	1.10	7.49	4.31	7.51	1.27	11.91	4.64	8.81
CL# 8(b).11	3.09	5.55	6.01	2.92	1.08	8.98	4.21	7.43	1.50	9.42	4.20	7.56
CL# 8(b).12	3.22	5.51	5.73	2.65	1.09	7.89	4.13	6.75	1.75	13.19	4.77	8.99
CL# 8(b).13	3.20	5.45	6.16	2.67	1.13	7.65	4.19	7.11	1.37	10.82	4.32	8.23
CL# 8(b).14	3.10	5.22	6.01	2.75	1.05	7.98	4.21	6.90	1.25	9.79	4.13	7.85
AVERAGE	3.19	5.51	5.96	2.76	1.09	8.19	4.11	7.03	1.51	10.18	4.43	8.24
St. Deviation	0.09	0.12	0.16	0.14	0.04	0.51	0.20	0.45	0.15	1.42	0.36	0.95
2 Σ of Mean	0.05	0.06	0.09	0.07	0.02	0.27	0.11	0.24	0.08	0.76	0.19	0.51
% St. Deviation	2.82	2.20	2.74	4.95	4.00	6.25	4.93	6.38	10.12	13.96	8.23	11.49

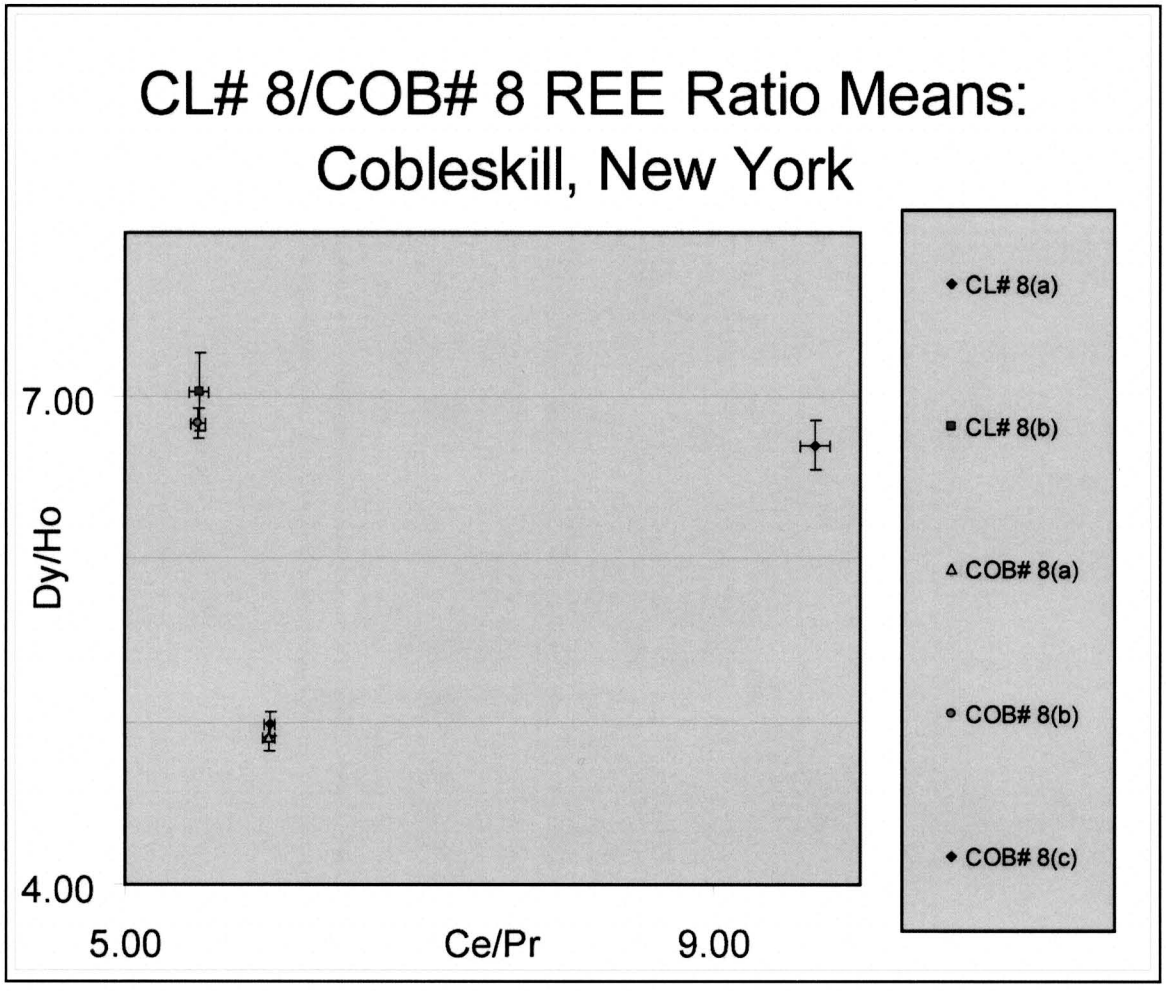
APPENDIX B.4.8:

Rare earth element ratios plots for layer CL# 8 from values listed in APPENDICES B.4.1 and B.4.5, in addition to values generated during identical geochemical analyses performed on grains from the same stratigraphic interval but sampled prior to this study and analyzed by Dr. George H. Shaw at Union College in Schenectady, New York. Plots generated from the K-bentonite layer COB# 8 are shown for analytical corroboration. Data populations have been subdivided and labeled based on similar geochemical ratio values. Scale and legend are given.



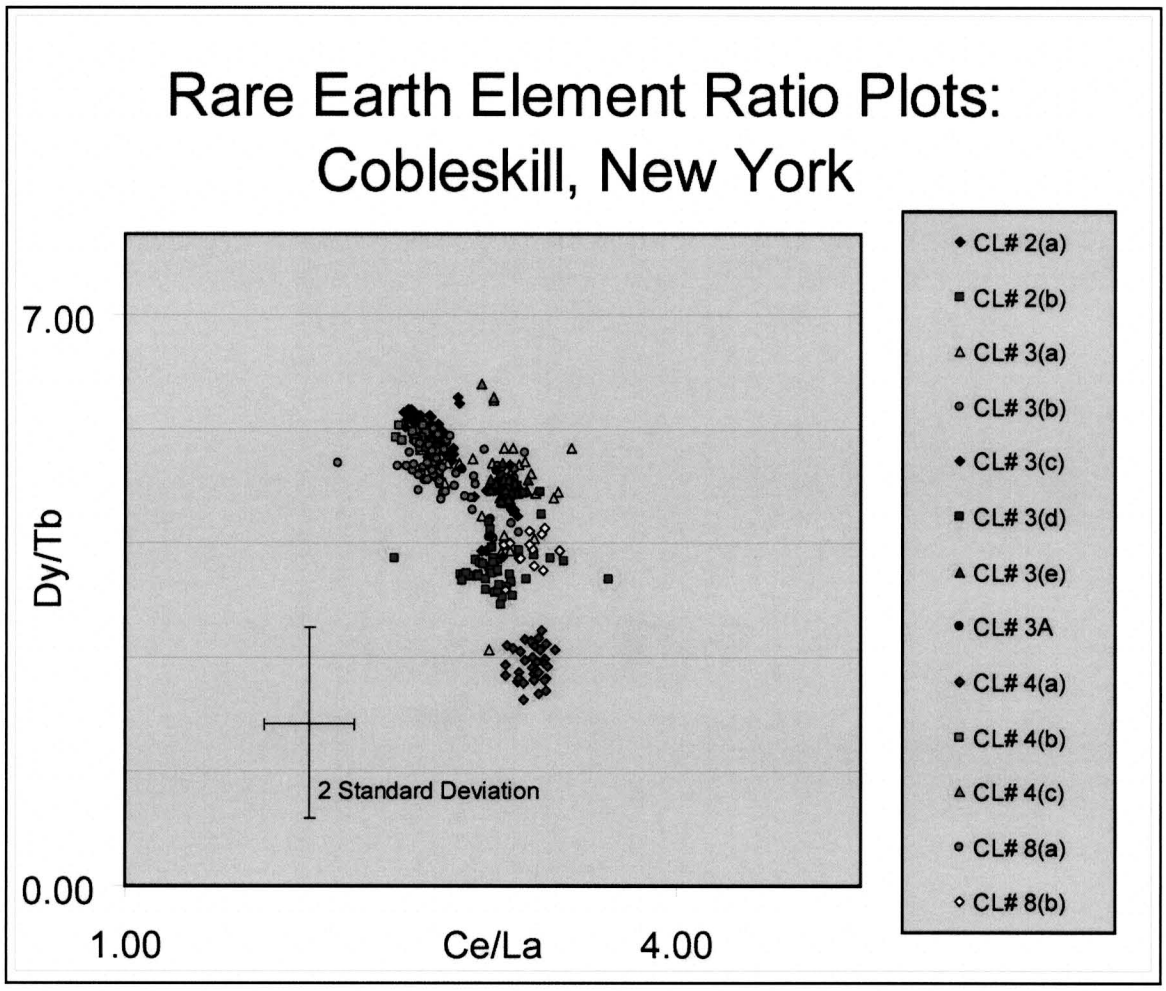
APPENDIX B.4.9:

Rare earth element ratios plots for layer CL# 8 from values listed in APPENDICES B.4.1 and B.4.5, in addition to values generated during identical geochemical analyses performed on grains from the same stratigraphic interval but sampled prior to this study and analyzed by Dr. George H. Shaw at Union College in Schenectady, New York. Plots generated from the K-bentonite layer COB# 8 are shown for analytical corroboration. Data populations have been subdivided and labeled based on similar geochemical ratio values. Error bars are 2 Sigma standard error of the mean. Scale has been exaggerated in order to show the separation of plots from one another. Scale and legend are given.



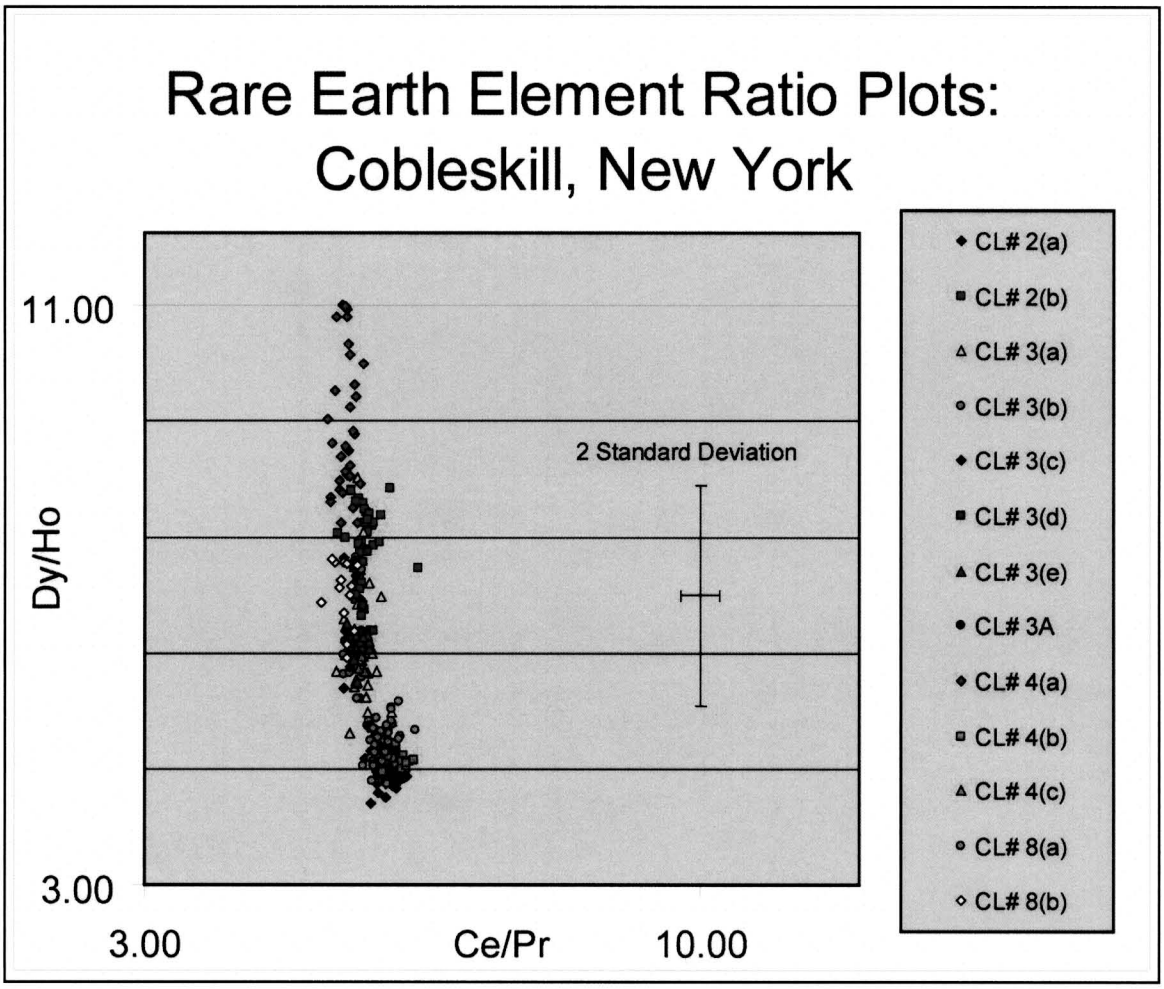
APPENDIX B.5.1:

Rare earth element ratios plots for all K-bentonite layers analyzed from Locality A. Analytes in this plot are Cerium, Lanthanum, Dysprosium, and Terbium. Scale and legend are given.



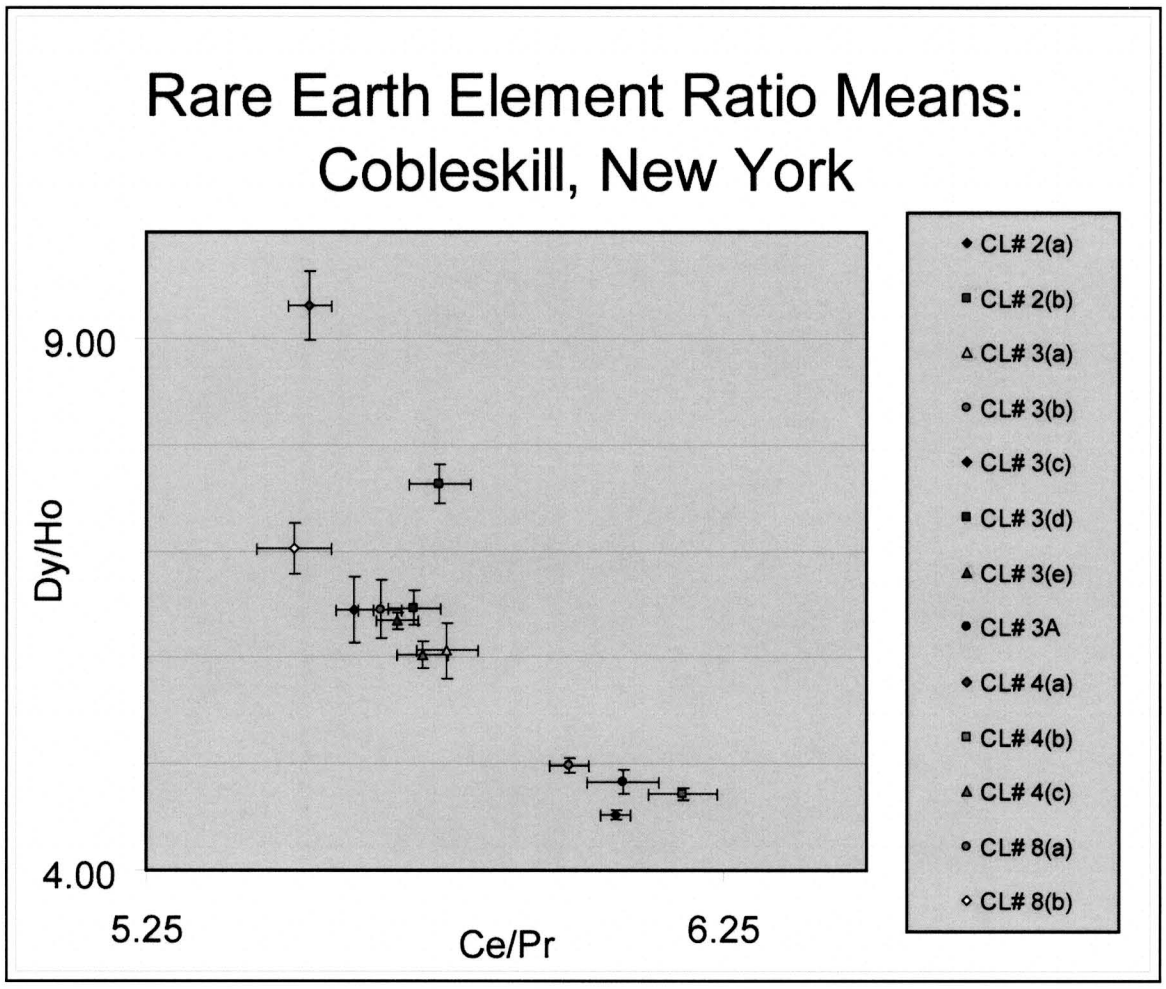
APPENDIX B.5.2:

Rare earth element ratios plots for all K-bentonite layers analyzed from Locality A. Analytes in this plot are Cerium, Praseodymium, Dysprosium, and Holmium. Scale and legend are given.



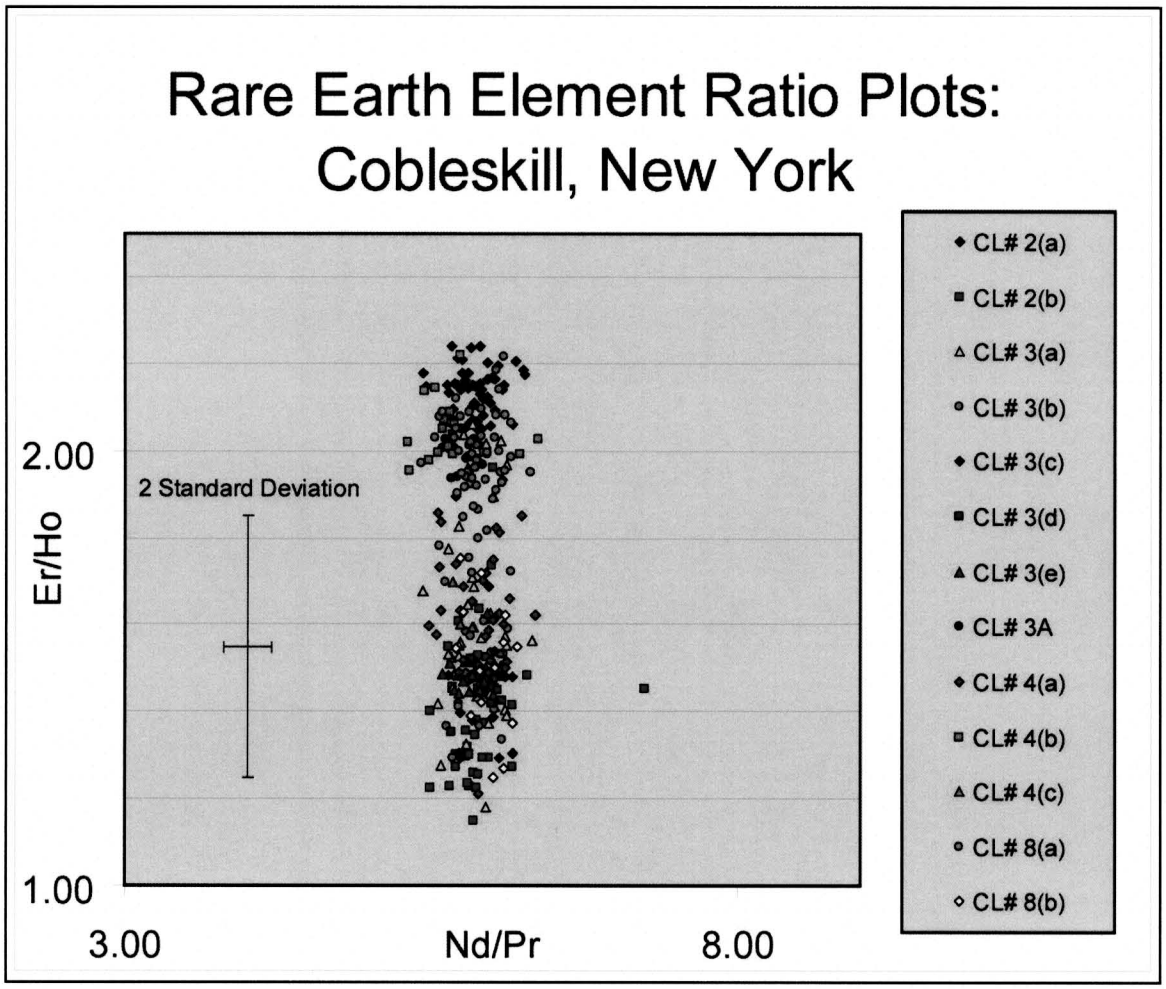
APPENDIX B.5.3:

Mean rare earth element ratios plots for all K-bentonite layers analyzed from Locality A. Analytes in this plot are Cerium, Praseodymium, Dysprosium, and Holmium. Error bars are 2 sigma standard error of the mean. Scale has been exaggerated for easier viewing. Scale and legend are given.



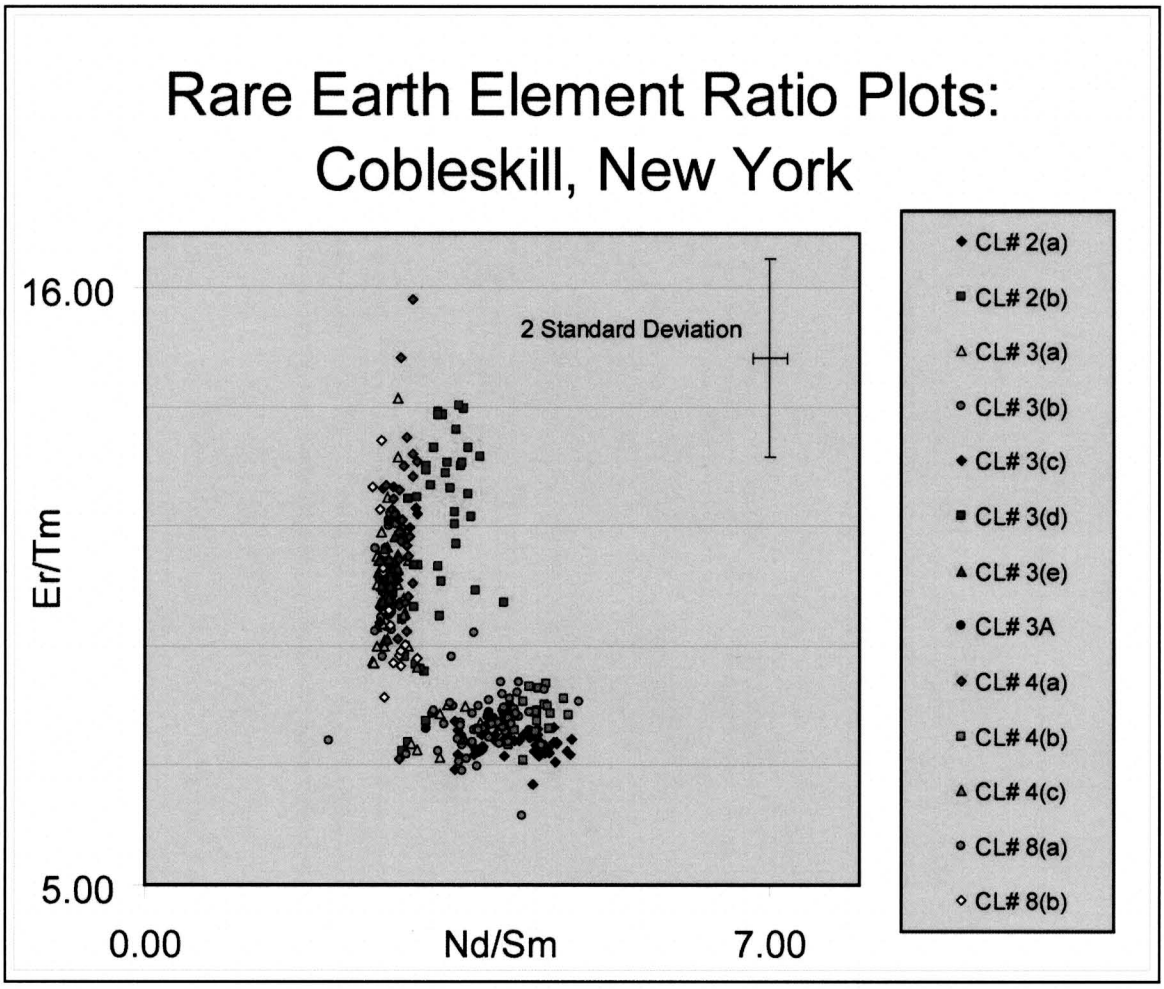
APPENDIX B.5.4:

Rare earth element ratios plots for all K-bentonite layers analyzed from Locality A. Analytes in this plot are Neodymium, Praseodymium, Erbium, and Holmium. Scale and legend are given.



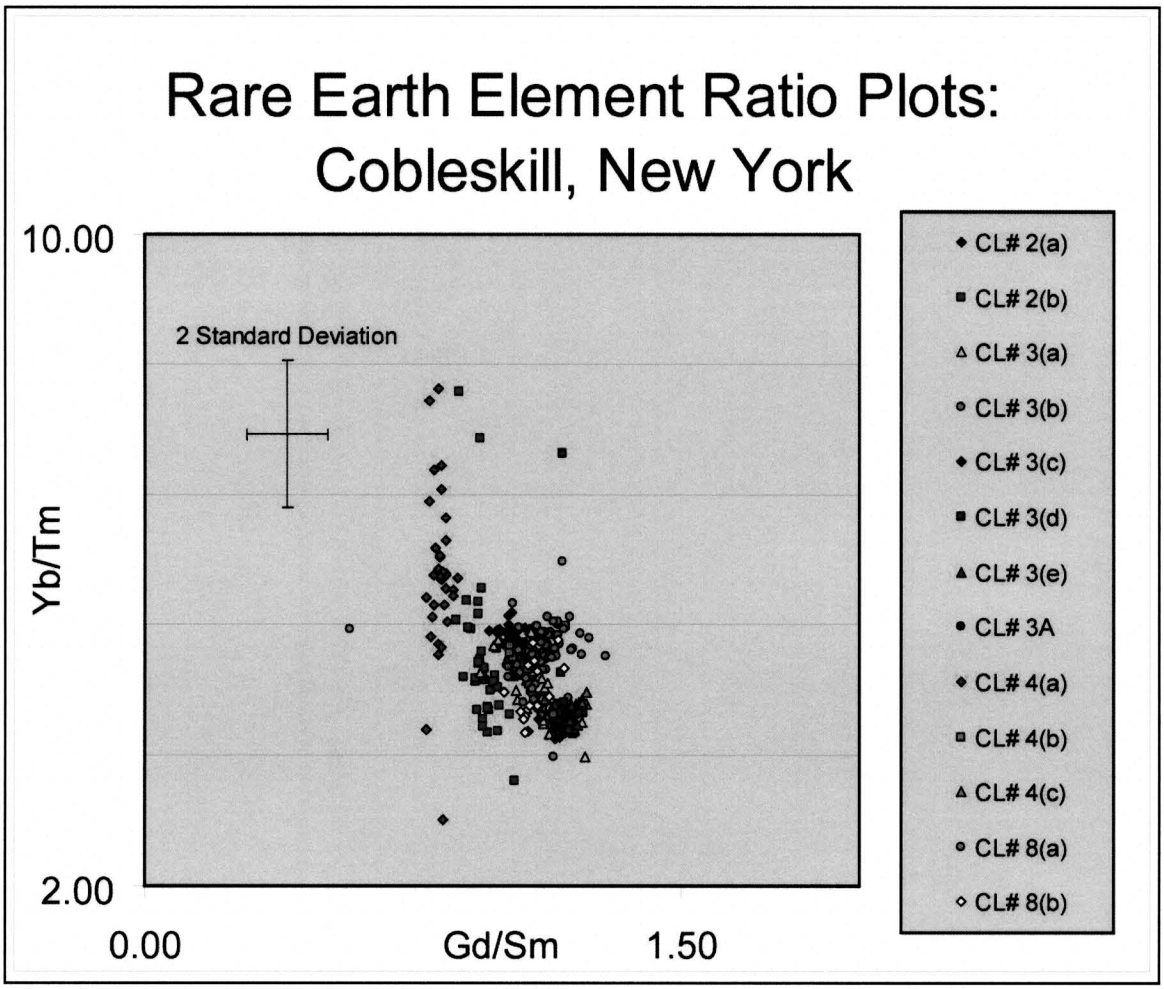
APPENDIX B.5.5:

Rare earth element ratios plots for all K-bentonite layers analyzed from Locality A. Analytes in this plot are Neodymium, Samarium, Erbium, and Thulium. Scale and legend are given.



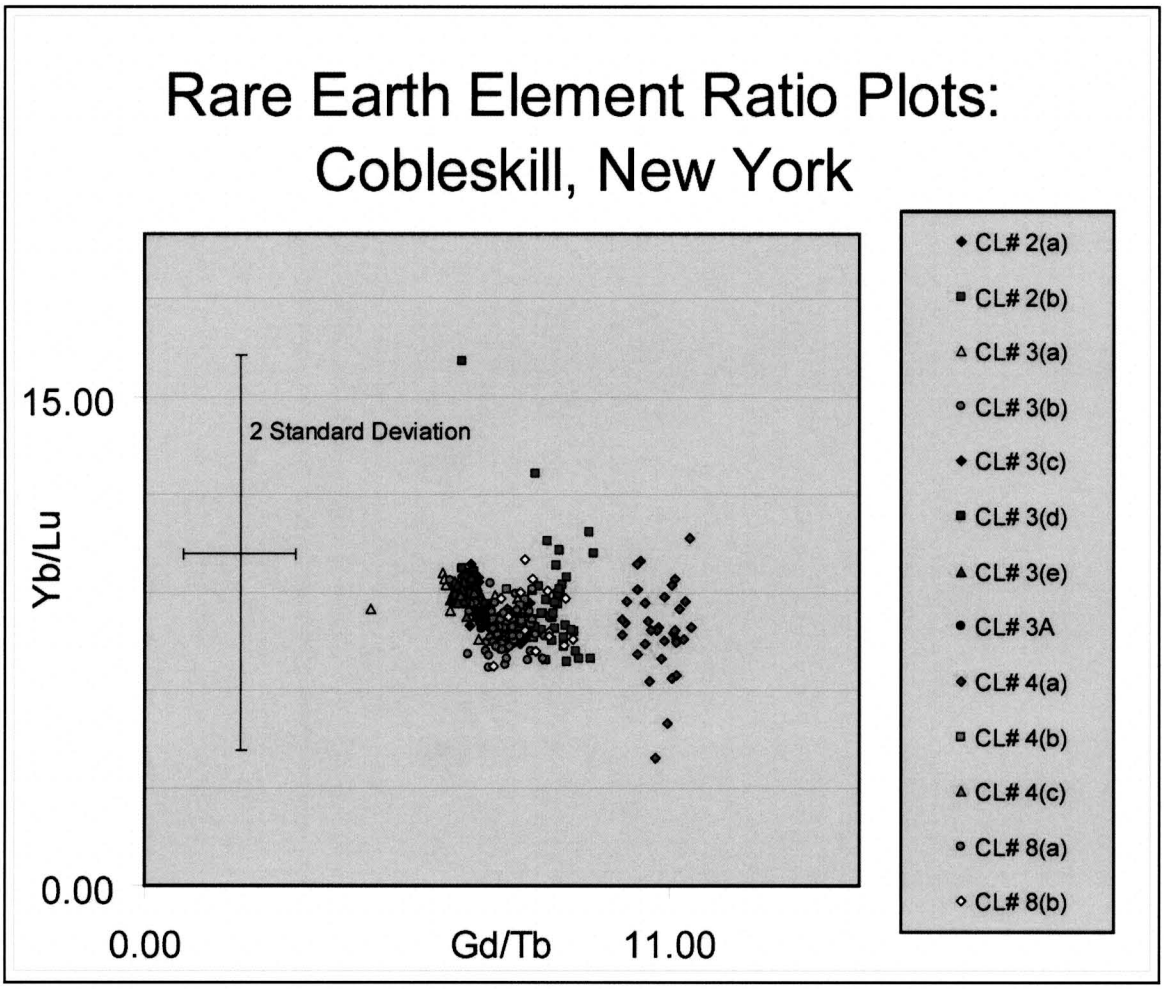
APPENDIX B.5.6:

Rare earth element ratios plots for all K-bentonite layers analyzed from Locality A. Analytes in this plot are Gadolinium, Samarium, Ytterbium, and Thulium. Scale and legend are given.



APPENDIX B.5.7:

Rare earth element ratios plots for all K-bentonite layers analyzed from Locality A. Analytes in this plot are Gadolinium, Terbium, Ytterbium, and Lutetium. Scale and legend are given.



APPENDIX B.6.1:

Trace element concentrations obtained from ICP-MS analysis of individual apatite phenocrysts from within the Tioga B K-bentonite layer Oak 0-4.5 from the Locality C. Since individual crystal weights could not be measured, values shown have no units. Average, standard deviation, 2 sigma standard error of the mean and percent standard deviation values are shown below each analyte used in further analyses.

Sample Name	P	Ca	Ca/P*	Sr	Y	La	Ce	Pr	Nd	Sm
Oak 0-4.5.01	1138.12	1880.29	0.78	0.11	18.41	2.37	7.42	1.31	7.55	2.44
Oak 0-4.5.02	2562.82	4693.76	0.87	0.90	36.82	5.07	15.62	2.79	16.15	5.27
Oak 0-4.5.03	2285.76	3933.97	0.81	0.58	36.44	4.72	14.18	2.52	14.69	4.83
Oak 0-4.5.04	3646.50	6485.58	0.84	1.30	55.16	7.06	22.04	3.97	22.19	7.55
Oak 0-4.5.05	2725.00	4722.81	0.82	1.17	32.97	7.45	22.32	3.81	21.86	6.35
Oak 0-4.5.06	1325.18	2482.01	0.89	0.81	20.37	2.73	8.12	1.46	8.47	2.82
Oak 0-4.5.07	2050.13	3239.10	0.75	0.17	29.84	3.61	11.24	2.01	11.90	4.08
Oak 0-4.5.08	6328.78	10592.98	0.79	2.48	117.23	16.30	56.36	10.12	59.57	20.68
Oak 0-4.5.09	4858.11	10107.57	0.98	3.54	62.53	10.38	30.82	5.34	31.45	9.57
Oak 0-4.5.10	2039.58	4368.50	1.01	1.28	30.22	3.73	11.55	2.02	12.06	3.99
Oak 0-4.5.11	4361.11	9026.95	0.98	2.68	61.27	7.45	23.16	4.07	25.01	8.30
Oak 0-4.5.12	3054.24	6438.24	1.00	1.89	43.81	5.63	16.97	3.02	17.26	5.70
Oak 0-4.5.13	4637.33	9709.00	0.99	3.28	51.44	10.54	30.06	5.20	29.75	8.50
Oak 0-4.5.14	5011.04	10209.66	0.96	3.59	63.83	11.53	33.93	5.90	34.44	10.09
Oak 0-4.5.15	2612.39	5440.21	0.98	1.76	37.65	5.42	16.53	2.88	16.53	5.31
Oak 0-4.5.16	8913.80	18279.00	0.97	4.98	133.27	15.89	49.37	8.97	53.20	18.49
Oak 0-4.5.17	4962.53	10208.33	0.97	3.24	82.45	10.73	32.98	5.83	32.83	11.28
Oak 0-4.5.18	4303.83	8587.48	0.94	2.65	73.73	9.33	28.62	5.10	30.63	10.16
Oak 0-4.5.19	2893.35	6025.44	0.98	2.34	30.03	7.47	21.67	3.70	21.44	5.98
Oak 0-4.5.20	2065.30	4379.35	1.00	1.32	31.98	3.90	11.95	2.15	13.15	4.31
Oak 0-4.5.21	5791.97	11790.87	0.96	3.95	83.47	12.20	37.21	6.60	39.00	12.25
Oak 0-4.5.22	4879.31	9781.82	0.95	3.03	61.08	9.72	29.02	5.06	28.67	9.33
Oak 0-4.5.23	2763.93	5829.18	1.00	2.01	38.57	6.45	19.46	3.43	20.24	6.03
Oak 0-4.5.24	3176.43	6419.39	0.96	2.00	50.01	6.59	20.34	3.60	20.41	6.97
Oak 0-4.5.25	5173.67	10797.73	0.99	4.23	57.76	13.66	39.40	6.74	39.20	10.89
Oak 0-4.5.26	1944.88	4007.32	0.97	1.38	30.49	4.05	11.97	2.16	12.32	4.11
Oak 0-4.5.27	5877.34	11953.25	0.96	4.13	80.88	13.10	38.92	6.85	39.27	12.19
		Average		53.77	53.77	8.04	24.49	4.32	25.16	8.06
		St. Deviation		27.87	27.87	3.97	12.53	2.23	13.10	4.38
		2 Σ of Mean		10.73	10.73	1.53	4.82	0.86	5.04	1.69
		% St. Deviation		51.84	51.84	49.44	51.16	51.59	52.06	54.38

APPENDIX B.6.1 continued

Sample Name	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Pb	Th	U
Oak 0-4.5.01	0.05	2.90	0.52	3.32	0.77	1.68	0.24	1.17	0.14	6.77	0.07	0.22
Oak 0-4.5.02	0.12	6.09	1.10	7.12	1.57	3.57	0.51	2.55	0.31	6.19	0.10	0.29
Oak 0-4.5.03	0.12	5.68	1.03	6.54	1.50	3.29	0.47	2.31	0.28	7.50	0.08	0.42
Oak 0-4.5.04	0.18	8.99	1.62	10.54	2.40	5.28	0.76	3.78	0.47	7.81	0.09	0.55
Oak 0-4.5.05	0.13	6.73	1.10	6.63	1.46	3.18	0.42	2.05	0.25	6.55	0.16	0.37
Oak 0-4.5.06	0.07	3.39	0.61	3.74	0.89	1.96	0.28	1.40	0.17	1.19	0.04	0.21
Oak 0-4.5.07	0.09	4.79	0.89	5.59	1.30	2.88	0.42	2.06	0.25	7.58	0.04	0.31
Oak 0-4.5.08	0.29	24.92	4.13	25.15	5.52	11.72	1.62	7.70	0.95	-0.24	-0.07	0.62
Oak 0-4.5.09	0.22	11.30	1.93	11.88	2.66	5.83	0.78	3.89	0.47	0.40	0.49	0.75
Oak 0-4.5.10	0.10	5.06	0.89	5.92	1.27	2.78	0.42	2.10	0.25	-0.19	0.19	0.31
Oak 0-4.5.11	0.19	10.09	1.85	11.73	2.59	5.63	0.80	3.99	0.48	-0.04	0.24	0.60
Oak 0-4.5.12	0.14	7.10	1.27	8.31	1.88	4.08	0.59	2.99	0.37	0.42	0.10	0.48
Oak 0-4.5.13	0.20	9.78	1.60	9.84	2.24	4.81	0.66	3.22	0.40	-0.26	0.12	0.66
Oak 0-4.5.14	0.21	11.76	1.99	12.20	2.73	5.90	0.79	3.95	0.47	-0.21	0.20	0.68
Oak 0-4.5.15	0.12	6.59	1.10	7.04	1.60	3.51	0.48	2.33	0.29	0.73	0.08	0.36
Oak 0-4.5.16	0.42	22.40	3.98	25.52	5.72	12.30	1.84	9.48	1.16	0.07	0.28	1.14
Oak 0-4.5.17	0.27	13.73	2.42	15.47	3.58	7.95	1.12	5.62	0.67	0.05	0.21	0.90
Oak 0-4.5.18	0.23	12.35	2.21	14.01	3.24	7.11	1.04	5.18	0.61	-0.29	0.62	1.21
Oak 0-4.5.19	0.12	6.52	1.01	5.90	1.32	2.88	0.36	1.80	0.21	0.84	0.23	0.30
Oak 0-4.5.20	0.10	5.28	0.95	6.12	1.39	3.02	0.45	2.32	0.27	-0.21	0.12	0.38
Oak 0-4.5.21	0.28	14.63	2.57	15.97	3.69	8.13	1.14	5.54	0.67	-0.30	0.19	0.88
Oak 0-4.5.22	0.21	11.26	1.92	12.30	2.78	5.98	0.85	4.14	0.51	-0.42	0.24	0.77
Oak 0-4.5.23	0.14	7.43	1.24	7.77	1.72	3.81	0.51	2.47	0.30	0.13	0.12	0.34
Oak 0-4.5.24	0.16	8.74	1.51	9.84	2.19	4.79	0.67	3.33	0.40	-0.52	0.14	0.64
Oak 0-4.5.25	0.23	12.37	1.99	11.96	2.62	5.55	0.74	3.59	0.44	-0.09	0.67	0.73
Oak 0-4.5.26	0.11	5.10	0.91	5.79	1.35	3.03	0.43	2.02	0.25	0.17	0.09	0.38
Oak 0-4.5.27	0.28	14.77	2.50	15.58	3.55	7.81	1.07	5.35	0.64	0.04	0.17	0.98
Average	0.18	9.62	1.66	10.44	2.35	5.13	0.72	3.57	0.43	1.62	0.19	0.57
St. Deviation	0.08	5.28	0.90	5.60	1.25	2.68	0.39	1.93	0.24	3.01	0.17	0.28
2 Σ of Mean	0.03	2.03	0.35	2.16	0.48	1.03	0.15	0.74	0.09	1.16	0.06	0.11
% St. Deviation	46.64	54.93	54.23	53.70	53.20	52.28	53.61	54.10	54.65	185.97	89.26	48.54

APPENDIX B.6.2:

Percent relative standard deviation values for each element analyzed during ICP-MS analysis of individual apatite phenocrysts from within the Tioga B K-bentonite layer Oak 0-4.5 from Locality C. These percent values are generated during the 16 analytical passes, each containing 5 replicate analyses, for each individual crystal analyzed.

Sample Name	P	Ca	Sr	Y	La	Ce	Pr	Nd	Sm	Eu
Oak 0-4.5.01	8.51	7.45	50.40	3.22	4.73	2.08	1.53	5.94	5.36	7.15
Oak 0-4.5.02	4.32	6.73	5.44	3.53	1.71	2.47	1.18	4.87	3.44	5.36
Oak 0-4.5.03	5.00	5.94	5.00	2.52	2.64	1.64	2.18	3.53	2.88	4.95
Oak 0-4.5.04	3.80	4.98	7.53	5.48	1.93	1.29	2.94	4.30	4.71	6.11
Oak 0-4.5.05	3.31	2.68	3.40	2.70	0.98	3.13	1.31	4.85	2.37	6.00
Oak 0-4.5.06	6.68	6.21	7.22	2.39	3.62	2.20	3.12	6.36	3.75	7.09
Oak 0-4.5.07	2.81	5.84	5.94	0.60	4.68	1.60	2.05	3.04	3.60	9.04
Oak 0-4.5.08	2.58	5.91	7.17	3.88	4.25	3.25	2.35	4.30	1.22	13.00
Oak 0-4.5.09	5.28	3.94	1.50	1.23	3.06	2.12	2.58	2.10	4.35	6.88
Oak 0-4.5.10	4.36	4.91	2.07	2.48	0.79	2.35	3.01	2.66	3.23	5.08
Oak 0-4.5.11	4.87	4.71	1.50	1.53	1.78	2.83	0.64	3.81	3.68	6.77
Oak 0-4.5.12	4.35	4.79	2.22	1.60	2.67	1.30	4.01	2.56	4.20	4.49
Oak 0-4.5.13	5.04	5.56	1.65	1.72	0.85	1.64	2.27	3.15	0.82	3.53
Oak 0-4.5.14	3.07	4.62	1.11	2.96	0.77	1.46	1.12	4.01	1.35	4.10
Oak 0-4.5.15	6.45	6.31	1.56	2.46	1.69	3.14	2.60	5.08	3.02	6.35
Oak 0-4.5.16	4.44	5.75	1.09	1.48	1.80	1.14	2.71	2.70	1.59	2.59
Oak 0-4.5.17	4.48	3.52	2.92	2.75	1.37	1.94	1.39	3.61	3.75	5.76
Oak 0-4.5.18	11.39	4.06	2.39	2.51	2.02	1.88	2.10	3.17	3.06	6.19
Oak 0-4.5.19	5.58	5.12	2.33	2.51	1.52	2.00	1.76	3.76	2.60	9.29
Oak 0-4.5.20	8.77	7.91	2.77	3.71	5.75	2.68	3.05	7.19	3.59	7.49
Oak 0-4.5.21	3.74	2.43	1.61	1.99	3.84	2.20	2.54	3.65	3.98	5.17
Oak 0-4.5.22	5.25	4.98	3.45	2.79	1.56	3.17	1.83	4.84	1.80	10.11
Oak 0-4.5.23	6.35	4.87	3.78	4.06	1.92	2.89	1.55	6.73	2.42	9.73
Oak 0-4.5.24	6.21	5.17	1.90	2.49	3.01	1.30	2.01	2.80	2.73	3.99
Oak 0-4.5.25	5.15	5.50	2.80	2.51	2.66	1.69	1.58	6.45	2.93	6.88
Oak 0-4.5.26	5.96	5.73	1.62	2.85	4.48	1.11	4.75	6.88	3.27	6.33
Oak 0-4.5.27	3.90	3.55	2.42	2.11	2.04	2.42	2.02	3.49	2.50	2.98

APPENDIX B.6.2 continued

Sample Name	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Pb	Th	U
Oak 0-4.5.01	2.09	1.67	1.26	3.08	3.12	6.75	2.71	4.10	1.14	18.00	1.61
Oak 0-4.5.02	2.44	1.04	1.79	1.66	3.01	2.59	3.40	4.25	0.54	12.95	5.39
Oak 0-4.5.03	1.79	1.63	3.73	2.96	5.16	2.65	3.17	5.04	0.72	10.59	3.77
Oak 0-4.5.04	5.02	2.37	0.92	2.99	2.21	3.16	1.20	3.19	0.57	15.65	1.68
Oak 0-4.5.05	3.43	3.74	3.44	2.94	4.23	6.39	2.54	5.99	0.82	12.99	1.43
Oak 0-4.5.06	5.06	2.32	2.21	3.00	3.15	3.32	5.39	3.84	12.28	30.40	7.58
Oak 0-4.5.07	3.82	1.72	3.29	2.30	1.71	3.31	3.87	3.90	0.42	32.42	2.58
Oak 0-4.5.08	2.21	3.09	5.18	2.79	4.03	2.80	3.53	6.21	7.50	35.23	3.60
Oak 0-4.5.09	3.92	2.11	3.15	2.93	3.17	1.60	3.67	3.78	11.92	12.23	4.37
Oak 0-4.5.10	3.50	2.35	1.98	2.03	2.42	1.23	3.52	5.42	21.36	10.57	3.06
Oak 0-4.5.11	1.39	1.01	1.95	2.55	3.09	3.91	2.45	2.50	218.86	12.94	2.55
Oak 0-4.5.12	1.90	1.79	1.73	2.87	1.51	2.08	2.61	1.99	12.61	9.68	5.88
Oak 0-4.5.13	1.77	2.91	2.42	3.82	4.67	1.69	3.28	1.21	22.35	18.63	1.24
Oak 0-4.5.14	2.84	2.95	3.68	2.64	1.16	2.91	3.06	3.79	21.17	8.42	3.69
Oak 0-4.5.15	2.21	2.53	2.92	3.48	4.28	2.69	2.40	2.14	13.11	10.94	4.40
Oak 0-4.5.16	1.26	2.05	2.04	1.65	1.91	2.75	3.52	1.76	18.24	10.15	2.93
Oak 0-4.5.17	3.24	2.74	2.06	2.27	1.16	0.57	2.03	2.49	107.05	6.18	2.67
Oak 0-4.5.18	2.80	1.52	3.30	2.87	3.14	2.37	1.80	3.67	18.46	10.26	2.70
Oak 0-4.5.19	2.92	2.72	3.33	3.10	3.16	3.67	4.75	1.97	6.76	10.62	2.54
Oak 0-4.5.20	4.69	1.19	2.28	2.42	3.91	1.78	3.20	3.95	34.68	22.71	6.06
Oak 0-4.5.21	3.07	1.88	1.70	2.64	1.25	1.80	2.88	3.48	19.12	12.29	3.35
Oak 0-4.5.22	2.19	2.09	3.19	1.50	4.50	3.99	2.41	3.71	4.72	7.13	2.24
Oak 0-4.5.23	3.25	1.06	2.61	2.34	3.38	4.32	3.66	2.92	52.66	17.28	4.27
Oak 0-4.5.24	2.24	4.21	3.57	4.35	3.72	2.47	4.60	4.47	3.83	14.35	2.16
Oak 0-4.5.25	3.00	2.19	1.83	3.13	4.24	1.90	2.53	2.01	44.41	5.56	1.32
Oak 0-4.5.26	3.74	2.40	2.18	3.13	4.96	3.08	1.98	2.64	18.57	5.45	4.04
Oak 0-4.5.27	1.69	1.60	2.38	2.55	3.42	1.91	1.15	2.54	79.82	5.98	3.68

APPENDIX B.6.3:

Rare earth element ratios derived from trace element concentration values found in Appendix B.6.1 for individual apatite phenocrysts from the layer Oak 0-4.5 from Locality C. Mean, standard deviation, 2 Sigma standard error of the mean, and percent standard deviation values for trace elements are below each ratio.

Sample Name	Ce/La	Ce/Pr	Nd/Pr	Nd/Sm	Gd/Sm	Gd/Tb	Dy/Tb	Dy/Ho	Er/Ho	Er/Tm	Yb/Tm	Yb/Lu
Oak 0-4.5.01	3.13	5.65	5.75	3.09	1.19	5.61	6.42	4.30	2.17	7.10	4.96	8.29
Oak 0-4.5.02	3.08	5.61	5.80	3.06	1.15	5.51	6.45	4.55	2.28	6.97	4.97	8.31
Oak 0-4.5.03	3.01	5.62	5.82	3.04	1.17	5.51	6.35	4.37	2.20	6.98	4.91	8.25
Oak 0-4.5.04	3.12	5.55	5.59	2.94	1.19	5.55	6.51	4.39	2.20	6.91	4.94	8.12
Oak 0-4.5.05	3.00	5.86	5.74	3.44	1.06	6.09	6.00	4.55	2.18	7.54	4.86	8.34
Oak 0-4.5.06	2.97	5.55	5.79	3.00	1.20	5.57	6.14	4.23	2.22	7.07	5.03	8.39
Oak 0-4.5.07	3.11	5.59	5.92	2.91	1.17	5.41	6.31	4.30	2.22	6.87	4.91	8.23
Oak 0-4.5.08	3.46	5.57	5.89	2.88	1.21	6.03	6.09	4.56	2.12	7.23	4.75	8.10
Oak 0-4.5.09	2.97	5.77	5.88	3.29	1.18	5.85	6.16	4.47	2.20	7.43	4.95	8.34
Oak 0-4.5.10	3.09	5.71	5.97	3.02	1.27	5.69	6.67	4.66	2.18	6.62	5.00	8.39
Oak 0-4.5.11	3.11	5.70	6.15	3.01	1.22	5.47	6.36	4.54	2.18	7.07	5.01	8.26
Oak 0-4.5.12	3.01	5.62	5.72	3.03	1.24	5.58	6.53	4.41	2.17	6.92	5.07	8.08
Oak 0-4.5.13	2.85	5.78	5.73	3.50	1.15	6.11	6.14	4.40	2.15	7.33	4.90	8.13
Oak 0-4.5.14	2.94	5.75	5.83	3.41	1.17	5.91	6.14	4.47	2.16	7.45	5.00	8.36
Oak 0-4.5.15	3.05	5.75	5.75	3.11	1.24	5.97	6.38	4.40	2.19	7.32	4.86	8.07
Oak 0-4.5.16	3.11	5.51	5.93	2.88	1.21	5.62	6.41	4.46	2.15	6.69	5.16	8.20
Oak 0-4.5.17	3.07	5.66	5.63	2.91	1.22	5.68	6.40	4.32	2.22	7.10	5.03	8.35
Oak 0-4.5.18	3.07	5.62	6.01	3.01	1.22	5.59	6.34	4.32	2.19	6.81	4.96	8.47
Oak 0-4.5.19	2.90	5.85	5.79	3.58	1.09	6.46	5.84	4.46	2.18	8.04	5.01	8.61
Oak 0-4.5.20	3.07	5.55	6.11	3.05	1.23	5.59	6.47	4.40	2.17	6.73	5.18	8.64
Oak 0-4.5.21	3.05	5.63	5.91	3.18	1.19	5.69	6.22	4.33	2.20	7.13	4.86	8.24
Oak 0-4.5.22	2.99	5.74	5.67	3.07	1.21	5.87	6.42	4.42	2.15	7.06	4.89	8.07
Oak 0-4.5.23	3.02	5.67	5.90	3.36	1.23	5.98	6.25	4.51	2.21	7.46	4.84	8.29
Oak 0-4.5.24	3.09	5.65	5.67	2.93	1.25	5.80	6.53	4.50	2.19	7.19	5.00	8.38
Oak 0-4.5.25	2.88	5.85	5.82	3.60	1.14	6.21	6.01	4.56	2.12	7.51	4.86	8.15
Oak 0-4.5.26	2.95	5.53	5.70	3.00	1.24	5.60	6.36	4.30	2.25	7.12	4.74	8.19
Oak 0-4.5.27	2.97	5.68	5.73	3.22	1.21	5.92	6.24	4.38	2.20	7.29	4.99	8.39
Average	3.04	5.67	5.82	3.13	1.19	5.77	6.30	4.43	2.19	7.15	4.95	8.28
St. Deviation	0.11	0.10	0.14	0.22	0.05	0.26	0.19	0.10	0.03	0.31	0.10	0.15
2 Σ of Mean	0.04	0.04	0.05	0.08	0.02	0.10	0.07	0.04	0.01	0.12	0.04	0.06
% St. Deviation	3.72	1.76	2.37	6.96	3.95	4.48	3.01	2.33	1.59	4.32	2.09	1.81

APPENDIX B.6.4:

Trace element concentrations obtained from ICP-MS analysis of individual apatite phenocrysts from within the Tioga B K-bentonite layer Oak 0-16.0 from Locality C. Since individual crystal weights could not be measured, values shown have no units. Average, standard deviation, 2 sigma standard error of the mean and percent standard deviation values are shown below each analyte used in further analyses.

Sample Name	P	Ca	Ca/P*	Sr	Y	La	Ce	Pr	Nd	Sm
Oak 0-16.0.01	5878.55	11944.78	0.96	3.39	89.26	10.72	33.77	5.96	36.15	12.06
Oak 0-16.0.02	2380.35	5334.11	1.06	1.67	37.45	4.77	14.70	2.60	16.18	5.23
Oak 0-16.0.03	2759.29	5836.59	1.00	1.67	47.62	5.61	17.29	3.14	20.50	6.36
Oak 0-16.0.04	5924.94	12899.14	1.03	3.93	123.12	14.13	43.33	7.89	49.87	15.69
Oak 0-16.0.05	3736.60	7816.15	0.99	2.11	56.08	7.46	22.18	4.00	25.99	7.78
Oak 0-16.0.06	2385.69	5138.49	1.02	1.24	38.96	4.48	14.16	2.51	16.65	5.23
Oak 0-16.0.07	5257.58	11022.35	0.99	2.83	73.49	9.38	28.46	5.11	31.75	10.33
Oak 0-16.0.08	1743.79	3471.45	0.94	0.99	31.06	3.48	11.41	2.07	12.23	3.98
Oak 0-16.0.09	2089.48	4466.44	1.01	1.09	35.38	4.17	12.82	2.34	14.66	4.59
Oak 0-16.0.10	2452.21	5036.93	0.97	1.79	30.78	6.01	17.40	3.08	18.82	5.46
Oak 0-16.0.11	4131.65	8850.14	1.01	2.25	59.65	6.76	21.31	3.90	23.66	8.11
Oak 0-16.0.12	2446.31	4891.89	0.95	1.15	35.37	4.22	13.52	2.42	13.33	5.03
Oak 0-16.0.13	4962.06	9892.79	0.94	2.62	73.14	8.94	28.37	4.96	29.51	10.30
Oak 0-16.0.14	1926.36	3741.35	0.92	1.18	30.47	3.29	11.49	1.92	10.47	3.96
Oak 0-16.0.15	3291.99	6756.94	0.97	1.83	53.69	6.50	20.07	3.57	21.29	7.19
Oak 0-16.0.16	2697.93	5466.54	0.96	1.92	37.30	5.08	16.17	2.73	14.76	5.15
Oak 0-16.0.17	3124.20	5972.54	0.90	1.79	43.82	5.34	17.63	2.93	16.00	5.62
Oak 0-16.0.18	2297.78	4604.07	0.95	1.48	43.43	4.95	16.13	2.75	15.19	5.52
Oak 0-16.0.19	2206.77	4231.94	0.91	1.24	37.02	4.49	14.74	2.52	13.80	5.05
Oak 0-16.0.20	4951.62	9744.41	0.93	3.72	69.49	11.58	35.38	6.06	33.68	10.64
Oak 0-16.0.21	6900.17	13342.70	0.90	4.11	97.99	13.00	40.99	7.18	39.28	13.87
Oak 0-16.0.22	2054.41	4188.06	0.95	0.72	29.92	3.77	11.98	2.09	11.48	4.10
Oak 0-16.0.23	3281.02	6806.26	0.96	1.30	50.52	6.22	19.53	3.50	19.70	7.05
Oak 0-16.0.24	3202.89	6687.70	0.97	1.60	46.06	5.55	17.69	3.21	18.19	6.44
Oak 0-16.0.25	1873.45	3558.18	0.88	0.48	24.68	3.27	10.31	1.78	9.64	3.48
Oak 0-16.0.26	6611.09	13369.41	0.94	3.85	97.10	12.15	37.94	6.76	38.76	13.16
Oak 0-16.0.27	3952.20	8175.32	0.96	2.05	60.18	7.45	22.75	4.11	22.76	8.26
Oak 0-16.0.28	1469.96	3152.92	1.00	0.15	19.63	2.51	7.89	1.44	8.16	2.94
Oak 0-16.0.29	4645.20	9574.02	0.96	3.01	64.35	10.08	30.02	5.25	30.21	9.60
Oak 0-16.0.30	1252.68	2482.08	0.92	0.21	21.39	2.53	8.19	1.46	8.20	2.76
Oak 0-16.0.31	2001.18	4265.32	0.99	0.54	29.87	3.96	11.49	2.06	12.62	3.98
Oak 0-16.0.32	2960.20	6202.63	0.97	1.22	42.38	5.13	16.06	2.85	16.29	5.69
Oak 0-16.0.33	3872.94	7906.62	0.95	2.13	61.35	7.62	23.39	4.15	24.75	8.47
Oak 0-16.0.34	2290.54	5127.85	1.04	0.74	34.62	4.09	12.50	2.24	13.84	4.72
Oak 0-16.0.35	2787.78	6045.98	1.01	1.14	45.72	5.48	16.57	2.99	19.29	5.85
Oak 0-16.0.36	2079.54	4481.33	1.00	0.45	32.27	3.85	11.65	2.15	13.21	4.35
Oak 0-16.0.37	1998.43	4053.76	0.94	0.42	30.82	3.77	11.67	2.07	12.50	4.05
Oak 0-16.0.38	8538.72	17881.78	0.97	5.92	92.66	22.39	62.73	10.82	65.98	17.38
Oak 0-16.0.39	5534.48	11373.60	0.96	2.67	77.40	9.98	30.56	5.31	32.24	10.54
Oak 0-16.0.40	5674.00	11368.10	0.93	2.57	81.80	9.80	30.85	5.44	32.60	11.19
		Average		52.18	52.18	6.85	21.13	3.73	22.10	7.28
		St. Deviation		24.43	24.43	3.94	11.47	2.00	12.14	3.60
		2 Σ of Mean		7.73	7.73	1.25	3.63	0.63	3.84	1.14
		% St. Deviation		46.83	46.83	57.50	54.28	53.71	54.94	49.48

APPENDIX B.6.4 continued

Sample Name	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Pb	Th	U
Oak 0-16.0.01	0.29	14.45	2.67	17.24	3.91	8.42	1.22	6.20	0.75	-0.99	0.72	1.09
Oak 0-16.0.02	0.13	6.28	1.15	7.41	1.73	3.67	0.54	2.71	0.34	0.60	0.16	0.30
Oak 0-16.0.03	0.19	7.80	1.36	8.99	1.96	4.19	0.62	3.12	0.40	-0.60	1.77	0.50
Oak 0-16.0.04	0.40	18.97	3.41	22.67	5.07	10.96	1.64	8.24	1.03	0.11	1.15	0.70
Oak 0-16.0.05	0.20	9.44	1.68	10.89	2.50	5.25	0.77	4.00	0.48	-0.91	0.41	0.59
Oak 0-16.0.06	0.13	6.22	1.12	7.34	1.61	3.47	0.51	2.61	0.32	-1.07	0.15	0.45
Oak 0-16.0.07	0.25	12.70	2.24	14.77	3.31	7.06	1.04	5.36	0.66	-0.94	0.41	0.84
Oak 0-16.0.08	0.10	4.88	0.87	5.77	1.30	2.78	0.41	2.05	0.25	-1.35	0.23	0.23
Oak 0-16.0.09	0.11	5.81	1.01	6.68	1.52	3.21	0.48	2.43	0.30	-1.20	0.07	0.40
Oak 0-16.0.10	0.13	6.34	1.02	6.42	1.37	2.97	0.39	1.94	0.23	-0.56	0.37	0.39
Oak 0-16.0.11	0.18	9.92	1.77	11.30	2.43	5.14	0.77	3.80	0.47	-0.78	0.36	0.68
Oak 0-16.0.12	0.11	5.97	1.11	7.05	1.58	3.51	0.52	2.61	0.31	-0.93	0.12	0.43
Oak 0-16.0.13	0.25	12.21	2.26	14.65	3.31	7.31	1.05	5.34	0.64	-1.00	0.55	0.61
Oak 0-16.0.14	0.09	4.76	0.89	5.75	1.28	2.86	0.40	2.04	0.25	-0.66	0.11	0.29
Oak 0-16.0.15	0.17	8.77	1.61	10.32	2.37	5.11	0.74	3.75	0.45	-0.90	0.23	0.88
Oak 0-16.0.16	0.12	6.19	1.10	7.01	1.61	3.54	0.50	2.49	0.30	0.81	0.23	0.40
Oak 0-16.0.17	0.14	7.04	1.27	8.25	1.88	4.11	0.59	2.95	0.34	-1.15	0.12	0.49
Oak 0-16.0.18	0.13	6.66	1.22	8.05	1.81	4.10	0.59	2.94	0.35	-0.85	0.46	0.48
Oak 0-16.0.19	0.12	5.95	1.12	7.32	1.68	3.65	0.52	2.67	0.32	-0.91	0.23	0.14
Oak 0-16.0.20	0.24	12.45	2.09	12.86	2.83	6.03	0.82	4.01	0.48	-0.78	0.39	0.86
Oak 0-16.0.21	0.34	16.92	2.99	18.79	4.25	9.26	1.28	6.44	0.77	0.83	0.97	1.09
Oak 0-16.0.22	0.10	5.04	0.92	5.95	1.36	2.89	0.43	2.15	0.26	-0.54	0.24	0.35
Oak 0-16.0.23	0.16	8.51	1.52	9.65	2.16	4.88	0.70	3.58	0.42	-0.31	0.20	0.65
Oak 0-16.0.24	0.15	8.05	1.43	8.82	1.97	4.38	0.63	3.19	0.39	-0.11	0.28	0.59
Oak 0-16.0.25	0.08	4.20	0.74	4.61	1.08	2.35	0.33	1.67	0.20	-0.93	0.05	0.26
Oak 0-16.0.26	0.35	16.53	2.87	18.41	4.14	8.97	1.25	6.20	0.75	-0.63	1.62	1.33
Oak 0-16.0.27	0.20	10.03	1.79	11.26	2.66	5.74	0.83	4.28	0.52	1.01	0.85	0.82
Oak 0-16.0.28	0.07	3.64	0.62	3.87	0.89	1.87	0.28	1.40	0.17	-0.81	0.03	0.22
Oak 0-16.0.29	0.23	12.01	2.03	12.42	2.79	5.95	0.82	4.04	0.50	0.78	0.12	0.76
Oak 0-16.0.30	0.07	3.41	0.63	3.90	0.89	2.03	0.30	1.45	0.17	0.38	0.08	0.15
Oak 0-16.0.31	0.10	4.97	0.86	5.69	1.34	2.90	0.42	2.09	0.25	-0.95	0.34	0.35
Oak 0-16.0.32	0.14	7.09	1.27	7.84	1.83	3.99	0.58	3.03	0.36	1.62	0.31	0.52
Oak 0-16.0.33	0.22	10.29	1.80	11.48	2.61	5.76	0.83	4.14	0.48	-0.19	1.14	10.02
Oak 0-16.0.34	0.10	5.80	0.99	6.39	1.42	3.07	0.45	2.31	0.27	-0.33	0.10	0.29
Oak 0-16.0.35	0.14	7.57	1.31	8.48	1.93	4.19	0.60	2.96	0.36	-0.69	0.12	0.48
Oak 0-16.0.36	0.10	5.58	0.98	6.30	1.41	3.15	0.45	2.27	0.27	-0.55	0.07	0.36
Oak 0-16.0.37	0.09	4.82	0.87	5.70	1.32	2.98	0.43	2.23	0.26	-0.92	0.07	0.27
Oak 0-16.0.38	0.38	19.72	3.08	18.19	4.04	8.48	1.15	5.59	0.67	-0.74	0.46	1.19
Oak 0-16.0.39	0.26	13.25	2.31	14.81	3.43	7.46	1.08	5.47	0.66	-0.16	0.22	0.80
Oak 0-16.0.40	0.25	13.75	2.47	15.93	3.56	7.95	1.15	5.81	0.70	0.29	0.18	0.94
Average	0.18	8.85	1.56	9.98	2.25	4.89	0.70	3.54	0.43	-0.42	0.39	0.80
St. Deviation	0.09	4.29	0.74	4.67	1.05	2.25	0.32	1.61	0.20	0.71	0.42	1.52
2 Σ of Mean	0.03	1.36	0.23	1.48	0.33	0.71	0.10	0.51	0.06	0.22	0.13	0.48
% St. Deviation	49.49	48.48	47.12	46.77	46.43	46.03	45.78	45.58	46.29	-166.41	105.70	189.25

APPENDIX B.6.5:

Percent relative standard deviation values for each element analyzed during ICP-MS analysis of individual apatite phenocrysts from within the Tioga B K-bentonite layer Oak 0-16.0 from the Locality C. These percent values are generated during the 16 analytical passes, each containing 5 replicate analyses, for each individual crystal analyzed.

Sample Name	P	Ca	Sr	Y	La	Ce	Pr	Nd	Sm	Eu
Oak 0-16.0.01	3.39	2.47	3.30	3.22	2.60	1.39	1.51	4.33	1.84	5.38
Oak 0-16.0.02	4.02	3.26	3.16	3.71	2.57	1.68	3.00	6.13	4.61	4.22
Oak 0-16.0.03	8.86	7.16	1.21	2.02	4.25	2.71	1.07	4.68	3.00	4.06
Oak 0-16.0.04	3.73	5.23	1.26	1.84	3.62	0.60	1.80	3.43	1.12	5.82
Oak 0-16.0.05	6.38	3.79	3.24	2.48	2.00	1.72	2.90	6.45	2.68	5.33
Oak 0-16.0.06	5.51	7.90	4.56	1.94	3.01	1.77	2.97	4.03	2.51	5.58
Oak 0-16.0.07	2.09	1.94	1.54	2.70	3.62	2.94	3.68	9.00	1.59	3.95
Oak 0-16.0.08	9.43	8.74	2.24	3.34	4.22	2.95	2.83	5.67	4.71	7.57
Oak 0-16.0.09	6.66	8.47	2.78	2.86	2.78	2.12	2.42	4.14	4.80	10.68
Oak 0-16.0.10	4.83	2.15	1.91	4.27	1.74	2.62	1.97	3.06	2.02	8.39
Oak 0-16.0.11	6.38	4.93	2.43	2.31	2.15	2.59	1.95	5.21	3.92	7.20
Oak 0-16.0.12	2.67	0.77	4.06	2.29	2.27	2.42	4.44	5.65	4.95	6.28
Oak 0-16.0.13	2.03	2.91	1.78	1.93	3.90	2.32	3.11	7.86	4.64	4.44
Oak 0-16.0.14	6.33	6.83	4.86	2.93	0.84	2.62	2.48	6.91	2.31	9.21
Oak 0-16.0.15	1.55	1.61	2.42	3.29	4.46	1.95	3.17	7.91	5.57	7.77
Oak 0-16.0.16	3.15	2.43	2.78	4.54	2.10	2.53	1.39	5.03	2.64	9.59
Oak 0-16.0.17	1.94	2.52	4.64	3.65	4.66	2.45	2.79	3.64	2.36	8.50
Oak 0-16.0.18	5.47	6.02	2.31	3.50	1.90	5.29	3.25	1.99	3.46	12.61
Oak 0-16.0.19	8.35	4.07	4.57	3.31	2.07	2.83	2.99	7.95	2.50	6.39
Oak 0-16.0.20	3.37	3.32	1.92	1.52	3.00	1.42	2.36	2.99	1.76	4.30
Oak 0-16.0.21	3.60	3.91	1.94	2.53	2.73	1.86	2.30	4.21	1.68	1.69
Oak 0-16.0.22	2.98	3.17	3.00	3.49	1.53	2.47	3.60	8.87	2.63	8.77
Oak 0-16.0.23	5.02	5.68	1.44	2.23	3.03	2.73	2.15	5.04	3.55	10.27
Oak 0-16.0.24	6.82	5.74	2.20	1.14	3.16	0.79	3.71	4.33	1.65	6.35
Oak 0-16.0.25	5.15	1.96	5.21	2.93	4.42	4.27	3.51	3.49	2.63	10.78
Oak 0-16.0.26	1.47	3.30	1.34	2.39	1.47	2.36	1.48	4.74	1.47	5.37
Oak 0-16.0.27	3.73	4.65	2.94	2.20	2.77	3.62	2.24	3.85	2.11	5.59
Oak 0-16.0.28	3.57	1.23	17.06	1.64	3.11	2.89	3.67	3.76	1.40	14.32
Oak 0-16.0.29	3.38	2.67	2.58	2.58	1.75	3.05	1.28	4.12	3.26	7.49
Oak 0-16.0.30	3.69	3.98	10.22	1.34	4.93	3.33	4.48	8.66	3.61	11.44
Oak 0-16.0.31	6.00	3.85	3.29	3.79	2.47	1.80	4.15	7.21	2.16	7.27
Oak 0-16.0.32	3.04	2.93	3.20	4.02	2.15	1.42	1.28	5.37	2.66	7.55
Oak 0-16.0.33	1.23	2.80	2.45	4.87	0.77	1.90	3.34	2.22	1.82	5.87
Oak 0-16.0.34	3.49	5.48	4.92	4.30	3.43	3.84	3.59	2.38	4.15	8.87
Oak 0-16.0.35	2.37	3.60	4.48	2.33	2.59	2.57	3.67	3.92	3.64	7.02
Oak 0-16.0.36	3.90	6.17	7.94	4.89	4.36	2.31	2.36	2.27	3.38	5.79
Oak 0-16.0.37	6.07	4.46	8.20	2.64	2.66	1.61	1.79	9.28	4.70	15.70
Oak 0-16.0.38	2.45	0.96	0.85	2.05	1.05	2.18	2.67	3.12	1.78	5.02
Oak 0-16.0.39	3.60	2.21	1.51	2.71	2.13	1.02	2.92	4.89	3.25	6.93
Oak 0-16.0.40	2.11	0.98	4.37	3.33	1.46	3.27	1.31	6.77	2.97	4.97

APPENDIX B.6.5 continued

Sample Name	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Pb	Th	U
Oak 0-16.0.01	4.25	1.79	2.77	1.84	2.89	2.91	2.47	3.40	3.17	2.12	1.58
Oak 0-16.0.02	2.46	2.89	3.64	1.92	6.19	3.49	3.24	1.90	15.53	8.72	3.29
Oak 0-16.0.03	2.19	3.66	4.71	4.29	3.84	3.97	4.11	4.81	6.66	4.15	5.48
Oak 0-16.0.04	3.38	0.88	2.26	2.34	3.79	2.21	4.15	1.81	39.57	6.97	3.99
Oak 0-16.0.05	1.77	3.80	2.22	2.76	4.07	2.64	3.20	3.72	3.57	6.97	1.78
Oak 0-16.0.06	3.89	2.42	3.15	2.73	3.39	4.01	5.96	4.07	4.44	8.26	6.30
Oak 0-16.0.07	0.79	1.76	1.53	2.91	3.60	2.27	1.28	1.93	6.07	7.02	4.19
Oak 0-16.0.08	3.59	3.39	5.87	3.46	2.94	2.50	1.84	4.23	3.40	9.18	8.24
Oak 0-16.0.09	2.44	2.43	2.75	2.58	5.35	7.10	2.54	3.44	1.55	12.09	3.41
Oak 0-16.0.10	3.16	2.76	4.29	3.10	4.29	6.38	2.66	5.01	13.07	4.59	6.88
Oak 0-16.0.11	2.55	2.18	2.21	3.32	3.42	1.40	4.72	4.61	3.41	6.31	2.51
Oak 0-16.0.12	7.21	2.55	3.25	1.62	3.03	3.17	3.90	2.97	3.07	12.86	2.92
Oak 0-16.0.13	2.75	1.38	1.71	2.87	3.35	1.89	2.70	2.60	2.84	8.08	4.40
Oak 0-16.0.14	3.01	2.36	2.81	4.43	1.49	4.41	3.52	5.07	1.63	3.94	6.28
Oak 0-16.0.15	6.06	1.99	2.46	1.39	3.96	3.41	3.87	3.70	3.57	6.39	2.17
Oak 0-16.0.16	2.45	2.28	3.36	3.58	1.77	5.35	4.64	4.03	7.56	8.26	4.71
Oak 0-16.0.17	2.39	2.95	4.26	2.49	2.48	4.01	1.54	5.73	3.71	20.07	2.77
Oak 0-16.0.18	2.73	2.26	3.01	2.84	3.15	4.80	3.00	6.31	7.50	8.01	4.27
Oak 0-16.0.19	2.13	2.56	3.97	2.21	6.97	1.11	3.28	3.48	5.54	7.17	12.44
Oak 0-16.0.20	2.42	1.31	1.81	1.99	3.51	4.71	4.07	2.79	5.82	5.02	1.96
Oak 0-16.0.21	1.99	2.26	1.67	2.84	5.68	1.02	3.76	2.72	10.47	4.37	3.02
Oak 0-16.0.22	3.12	2.86	3.24	3.11	2.31	2.87	4.13	2.92	4.20	8.50	4.96
Oak 0-16.0.23	2.75	2.84	2.01	2.81	3.21	1.61	1.71	3.35	10.67	11.00	2.99
Oak 0-16.0.24	1.17	3.39	2.35	3.59	5.14	4.86	4.44	5.38	101.05	6.24	2.20
Oak 0-16.0.25	4.84	2.51	3.39	5.53	2.62	5.27	4.32	2.90	1.92	27.39	4.60
Oak 0-16.0.26	1.39	1.40	2.23	3.86	4.08	1.32	3.18	1.96	4.89	4.78	3.10
Oak 0-16.0.27	2.51	1.49	2.94	3.23	3.13	3.80	4.43	2.66	5.15	3.65	4.46
Oak 0-16.0.28	2.19	2.98	4.00	4.33	9.79	4.88	6.67	5.98	5.15	57.88	8.93
Oak 0-16.0.29	1.40	1.56	0.87	2.19	1.68	2.41	3.11	3.69	5.45	8.33	2.13
Oak 0-16.0.30	1.29	1.48	4.92	1.95	2.91	5.37	4.88	5.10	4.97	7.83	4.53
Oak 0-16.0.31	2.89	1.53	2.99	1.28	3.47	4.16	4.59	3.41	2.66	14.65	3.44
Oak 0-16.0.32	2.64	1.61	4.06	2.56	2.65	2.02	2.90	1.12	5.80	5.18	5.79
Oak 0-16.0.33	2.39	1.41	1.23	2.95	3.25	1.80	2.88	3.67	32.69	9.81	203.89
Oak 0-16.0.34	5.68	3.21	4.05	2.63	5.50	3.91	4.63	6.18	14.99	9.57	2.57
Oak 0-16.0.35	3.13	2.59	3.52	1.40	3.97	3.89	4.96	2.50	5.69	10.48	6.62
Oak 0-16.0.36	3.48	3.11	2.30	3.04	3.62	4.03	2.37	6.08	5.69	17.90	3.38
Oak 0-16.0.37	1.50	2.28	5.94	1.82	2.24	1.58	4.77	4.05	2.17	15.62	2.80
Oak 0-16.0.38	2.02	3.37	1.15	2.52	3.56	3.08	3.84	3.07	2.35	4.39	1.45
Oak 0-16.0.39	2.92	2.62	2.41	2.29	3.26	2.10	2.53	4.11	23.67	6.60	2.39
Oak 0-16.0.40	0.95	3.18	2.11	1.63	2.17	1.54	2.59	2.25	17.08	20.21	2.19

APPENDIX B.6.6:

Rare earth element ratios derived from trace element concentration values found in Appendix B.6.4 for individual apatite phenocrysts from the Tioga B K-bentonite layer Oak 0-16.0 from Locality C. Mean, standard deviation, 2 Sigma standard error of the mean, and percent standard deviation values for trace elements are below each ratio.

Sample Name	Ce/La	Ce/Pr	Nd/Pr	Nd/Sm	Gd/Sm	Gd/Tb
Oak 0-16.0.01	3.15	5.67	6.06	3.00	1.20	5.40
Oak 0-16.0.02	3.08	5.66	6.23	3.09	1.20	5.47
Oak 0-16.0.03	3.08	5.50	6.53	3.22	1.23	5.72
Oak 0-16.0.04	3.07	5.49	6.32	3.18	1.21	5.56
Oak 0-16.0.05	2.97	5.55	6.50	3.34	1.21	5.64
Oak 0-16.0.06	3.16	5.64	6.63	3.18	1.19	5.55
Oak 0-16.0.07	3.03	5.56	6.21	3.07	1.23	5.68
Oak 0-16.0.08	3.28	5.52	5.91	3.07	1.23	5.63
Oak 0-16.0.09	3.08	5.48	6.27	3.19	1.27	5.76
Oak 0-16.0.10	2.89	5.64	6.10	3.45	1.16	6.22
Oak 0-16.0.11	3.15	5.47	6.07	2.92	1.22	5.60
Oak 0-16.0.12	3.20	5.58	5.51	2.65	1.19	5.37
Oak 0-16.0.13	3.17	5.72	5.95	2.87	1.19	5.40
Oak 0-16.0.14	3.50	5.99	5.46	2.64	1.20	5.34
Oak 0-16.0.15	3.09	5.62	5.96	2.96	1.22	5.46
Oak 0-16.0.16	3.18	5.92	5.41	2.87	1.20	5.64
Oak 0-16.0.17	3.30	6.02	5.46	2.85	1.25	5.56
Oak 0-16.0.18	3.26	5.86	5.52	2.75	1.21	5.45
Oak 0-16.0.19	3.29	5.85	5.48	2.73	1.18	5.29
Oak 0-16.0.20	3.05	5.84	5.56	3.16	1.17	5.96
Oak 0-16.0.21	3.15	5.71	5.47	2.83	1.22	5.66
Oak 0-16.0.22	3.18	5.74	5.50	2.80	1.23	5.47
Oak 0-16.0.23	3.14	5.59	5.63	2.79	1.21	5.60
Oak 0-16.0.24	3.19	5.52	5.67	2.83	1.25	5.64
Oak 0-16.0.25	3.15	5.78	5.41	2.77	1.21	5.67
Oak 0-16.0.26	3.12	5.61	5.73	2.94	1.26	5.76
Oak 0-16.0.27	3.06	5.53	5.54	2.76	1.21	5.61
Oak 0-16.0.28	3.14	5.47	5.66	2.78	1.24	5.86
Oak 0-16.0.29	2.98	5.72	5.76	3.15	1.25	5.93
Oak 0-16.0.30	3.23	5.62	5.63	2.97	1.24	5.45
Oak 0-16.0.31	2.91	5.57	6.11	3.17	1.25	5.78
Oak 0-16.0.32	3.13	5.64	5.72	2.86	1.25	5.59
Oak 0-16.0.33	3.07	5.64	5.97	2.92	1.21	5.71
Oak 0-16.0.34	3.06	5.58	6.19	2.93	1.23	5.84
Oak 0-16.0.35	3.02	5.55	6.46	3.30	1.29	5.79
Oak 0-16.0.36	3.03	5.43	6.15	3.04	1.28	5.70
Oak 0-16.0.37	3.09	5.64	6.04	3.08	1.19	5.55
Oak 0-16.0.38	2.80	5.80	6.10	3.80	1.14	6.41
Oak 0-16.0.39	3.06	5.75	6.07	3.06	1.26	5.74
Oak 0-16.0.40	3.15	5.67	5.99	2.91	1.23	5.56
Average	3.12	5.65	5.90	3.00	1.22	5.65
St. Deviation	0.12	0.14	0.35	0.23	0.03	0.22
2 Σ of Mean	0.04	0.05	0.11	0.07	0.01	0.07
% St. Deviation	3.92	2.55	5.94	7.73	2.67	3.90

APPENDIX B.6.6 continued

Sample Name	Dy/Tb	Dy/Ho	Er/Ho	Er/Tm	Yb/Tm	Yb/Lu
Oak 0-16.0.01	6.45	4.41	2.16	6.89	5.07	8.23
Oak 0-16.0.02	6.45	4.29	2.12	6.81	5.03	8.06
Oak 0-16.0.03	6.59	4.59	2.14	6.72	5.01	7.82
Oak 0-16.0.04	6.64	4.47	2.16	6.70	5.04	8.01
Oak 0-16.0.05	6.50	4.36	2.10	6.79	5.18	8.30
Oak 0-16.0.06	6.55	4.55	2.15	6.84	5.14	8.27
Oak 0-16.0.07	6.61	4.46	2.13	6.80	5.16	8.12
Oak 0-16.0.08	6.66	4.45	2.14	6.84	5.05	8.14
Oak 0-16.0.09	6.63	4.41	2.12	6.69	5.05	8.14
Oak 0-16.0.10	6.30	4.68	2.17	7.68	5.01	8.58
Oak 0-16.0.11	6.38	4.64	2.11	6.69	4.95	8.17
Oak 0-16.0.12	6.34	4.46	2.22	6.80	5.06	8.34
Oak 0-16.0.13	6.48	4.43	2.21	6.94	5.07	8.30
Oak 0-16.0.14	6.45	4.51	2.24	7.09	5.04	8.12
Oak 0-16.0.15	6.42	4.36	2.16	6.88	5.05	8.25
Oak 0-16.0.16	6.39	4.37	2.20	7.02	4.94	8.20
Oak 0-16.0.17	6.52	4.39	2.19	6.98	5.01	8.58
Oak 0-16.0.18	6.59	4.44	2.26	7.00	5.01	8.32
Oak 0-16.0.19	6.52	4.35	2.17	6.95	5.08	8.42
Oak 0-16.0.20	6.16	4.55	2.13	7.33	4.87	8.29
Oak 0-16.0.21	6.29	4.42	2.18	7.23	5.03	8.37
Oak 0-16.0.22	6.46	4.38	2.13	6.80	5.06	8.28
Oak 0-16.0.23	6.35	4.47	2.26	7.00	5.13	8.43
Oak 0-16.0.24	6.18	4.48	2.22	7.00	5.09	8.21
Oak 0-16.0.25	6.23	4.25	2.16	7.08	5.03	8.18
Oak 0-16.0.26	6.42	4.45	2.17	7.19	4.97	8.22
Oak 0-16.0.27	6.30	4.23	2.16	6.94	5.17	8.29
Oak 0-16.0.28	6.23	4.37	2.11	6.77	5.08	8.24
Oak 0-16.0.29	6.13	4.45	2.13	7.25	4.92	8.15
Oak 0-16.0.30	6.24	4.37	2.28	6.81	4.85	8.36
Oak 0-16.0.31	6.62	4.26	2.17	6.93	5.01	8.50
Oak 0-16.0.32	6.18	4.29	2.19	6.92	5.25	8.44
Oak 0-16.0.33	6.37	4.39	2.20	6.98	5.01	8.54
Oak 0-16.0.34	6.44	4.52	2.17	6.87	5.16	8.57
Oak 0-16.0.35	6.48	4.39	2.17	6.99	4.94	8.29
Oak 0-16.0.36	6.43	4.48	2.24	6.99	5.06	8.36
Oak 0-16.0.37	6.56	4.32	2.26	6.99	5.25	8.59
Oak 0-16.0.38	5.91	4.50	2.10	7.38	4.86	8.29
Oak 0-16.0.39	6.41	4.32	2.18	6.92	5.07	8.26
Oak 0-16.0.40	6.45	4.48	2.23	6.94	5.07	8.30
Average	6.41	4.43	2.17	6.96	5.05	8.29
St. Deviation	0.16	0.10	0.05	0.20	0.09	0.16
2 Σ of Mean	0.05	0.03	0.02	0.06	0.03	0.05
% St. Deviation	2.57	2.26	2.21	2.91	1.82	1.98

APPENDIX B.7.1:

Trace element concentrations obtained from ICP-MS analysis of individual apatite phenocrysts from within the Tioga B K-bentonite layer identified as SF 0-5(a) from the Seneca Stone Quarry. Individual crystal weights could not be measured; therefore values shown have no units. Average, standard deviation, 2 sigma standard error of the mean and percent standard deviation values are shown below each analyte.

Sample Name	P	Ca	Ca/P*	Sr	Y	La	Ce	Pr	Nd	Sm
SF 0-5(a).01	2332.47	4155.17	0.84	1.67	29.74	7.85	24.77	4.30	25.72	9.52
SF 0-5(a).02	1611.46	2782.03	0.82	1.39	21.23	5.54	17.76	3.14	19.41	7.42
SF 0-5(a).03	1653.92	3038.10	0.87	1.32	16.73	5.44	16.98	3.09	18.54	7.03
SF 0-5(a).04	3574.90	7132.33	0.94	3.40	45.55	11.39	35.01	6.24	38.13	14.32
SF 0-5(a).05	9247.32	18558.09	0.95	9.11	89.83	27.51	84.33	14.71	91.89	31.71
SF 0-5(a).06	4131.88	8007.54	0.92	3.88	51.95	12.71	40.08	7.11	42.42	15.97
SF 0-5(a).07	2038.26	3720.98	0.86	1.58	26.09	6.79	21.27	3.85	23.96	8.44
SF 0-5(a).08	3275.86	6378.46	0.92	4.24	29.02	12.54	39.56	6.99	41.61	14.69
SF 0-5(a).09	8373.88	15270.80	0.86	6.35	138.96	32.80	106.71	19.30	111.98	44.81
SF 0-5(a).10	8889.80	16679.34	0.89	8.25	147.71	36.75	125.01	22.84	130.32	53.06
SF 0-5(a).11	787.59	1558.83	0.94	0.71	11.91	2.38	7.62	1.36	8.61	3.11
		Average		55.34	55.34	14.70	47.19	8.45	50.24	19.10
		St. Deviation		48.55	48.55	11.95	39.69	7.20	41.50	16.64
		2 Σ of Mean		29.27	29.27	7.21	23.93	4.34	25.02	10.03
		% St. Deviation		87.73	87.73	81.30	84.11	85.23	82.61	87.12

Sample Name	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Pb	Th	U
SF 0-5(a).01	0.49	10.48	1.58	7.57	1.20	1.77	0.16	0.66	0.07	5.90	1.06	0.30
SF 0-5(a).02	0.57	7.97	1.19	5.71	0.88	1.26	0.12	0.48	0.05	5.56	1.74	0.37
SF 0-5(a).03	0.48	7.58	1.10	4.89	0.69	0.91	0.08	0.33	0.04	5.85	1.62	0.30
SF 0-5(a).04	0.89	16.21	2.43	11.65	1.79	2.61	0.23	0.97	0.10	5.38	1.89	0.46
SF 0-5(a).05	1.80	33.08	4.71	23.04	3.81	6.68	0.79	3.79	0.46	5.59	3.17	1.28
SF 0-5(a).06	0.98	18.12	2.67	13.14	2.11	3.12	0.29	1.21	0.13	4.80	2.03	0.50
SF 0-5(a).07	0.52	9.55	1.37	6.49	1.03	1.48	0.13	0.55	0.07	5.75	0.99	0.29
SF 0-5(a).08	1.13	15.07	2.07	8.77	1.20	1.61	0.14	0.66	0.07	4.11	2.88	0.75
SF 0-5(a).09	2.28	53.30	8.29	40.48	6.79	10.51	1.01	4.00	0.48	-0.01	5.49	0.61
SF 0-5(a).10	3.39	60.91	8.84	41.84	6.53	9.22	0.83	2.96	0.36	-0.33	8.33	0.87
SF 0-5(a).11	0.21	3.54	0.55	2.79	0.49	0.82	0.08	0.36	0.04	-1.34	0.66	0.11
Average	1.16	21.44	3.16	15.13	2.41	3.64	0.35	1.45	0.17	3.75	2.71	0.53
St. Deviation	0.97	19.35	2.89	13.97	2.29	3.50	0.35	1.41	0.17	2.83	2.30	0.33
2 Σ of Mean	0.58	11.67	1.74	8.43	1.38	2.11	0.21	0.85	0.11	1.71	1.38	0.20
% St. Deviation	83.39	90.26	91.40	92.39	95.02	96.16	98.74	97.44	102.40	75.51	84.55	62.67

APPENDIX B.7.2:

Percent relative standard deviation values for each element analyzed during ICP-MS analysis of individual apatite phenocrysts from within the Tioga B K-bentonite layer identified as SF 0-5(a) from the Seneca Stone Quarry. These percent values are generated during the sixteen passes with five replicate analyses per pass for each individual apatite crystal analyzed.

Sample Name	P	Ca	Sr	Y	La	Ce	Pr	Nd	Sm	Eu
SF 0-5(a).01	3.43	3.41	5.12	3.95	5.83	6.04	4.99	4.81	7.07	3.88
SF 0-5(a).02	3.76	6.76	5.08	2.63	4.42	5.13	5.43	7.68	4.92	6.27
SF 0-5(a).03	6.37	6.02	3.62	2.91	4.19	1.43	1.62	3.89	4.03	2.33
SF 0-5(a).04	5.01	4.34	2.13	1.75	1.68	2.07	2.51	6.73	2.36	4.17
SF 0-5(a).05	3.01	2.82	1.58	3.79	1.83	2.55	2.35	3.28	0.69	1.53
SF 0-5(a).06	2.94	0.70	2.81	4.26	3.15	2.81	2.86	3.61	2.24	2.33
SF 0-5(a).07	3.54	5.66	2.55	4.06	2.76	2.57	2.73	4.59	2.06	3.34
SF 0-5(a).08	3.84	3.12	3.51	3.23	2.11	2.03	2.02	3.60	2.70	3.28
SF 0-5(a).09	2.49	4.46	3.31	4.00	2.21	3.64	1.19	4.06	1.77	2.51
SF 0-5(a).10	1.70	1.95	2.85	2.10	2.34	2.62	2.14	6.97	1.76	1.82
SF 0-5(a).11	6.26	8.25	2.23	2.34	1.35	1.89	2.20	6.33	0.75	5.46

Sample Name	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Pb	Th	U
SF 0-5(a).01	6.65	5.90	5.79	6.49	6.72	7.94	9.03	7.50	1.59	5.16	6.87
SF 0-5(a).02	7.01	5.98	4.29	7.90	6.82	5.44	7.29	6.69	2.16	2.13	6.49
SF 0-5(a).03	4.04	1.26	3.39	2.98	4.87	7.67	11.32	7.33	1.30	3.03	6.76
SF 0-5(a).04	3.53	2.20	3.15	3.45	1.79	2.47	3.73	4.73	1.14	3.46	4.32
SF 0-5(a).05	1.59	2.57	2.35	1.27	1.01	1.00	2.81	4.90	1.84	4.66	2.63
SF 0-5(a).06	5.17	0.55	3.20	3.15	1.83	2.58	4.08	4.13	2.75	5.32	3.90
SF 0-5(a).07	3.27	2.69	3.53	2.45	8.14	2.92	8.00	7.81	1.24	3.24	6.53
SF 0-5(a).08	2.44	0.92	5.62	3.75	6.00	5.05	4.84	3.90	4.47	5.14	2.11
SF 0-5(a).09	1.19	3.47	2.71	3.23	4.94	3.58	2.68	2.58	263.18	3.55	4.32
SF 0-5(a).10	2.53	3.53	4.70	4.45	3.96	5.93	7.13	8.48	2.82	6.04	4.10
SF 0-5(a).11	2.65	3.48	4.11	3.30	7.48	6.88	7.64	15.35	2.17	5.07	7.11

APPENDIX B.7.3:

Rare earth element ratios derived from trace element concentration values found in Appendix B.7.1 for individual apatite phenocrysts from the Tioga B K-bentonite layer identified as SF 0-5(a) from the Seneca Stone Quarry. Mean, standard deviation, 2 Sigma standard error of the mean, and percent standard deviation values for trace elements are below each ratio.

Sample Name	Ce/La	Ce/Pr	Nd/Pr	Nd/Sm	Gd/Sm	Gd/Tb	Dy/Tb	Dy/Ho	Er/Ho	Er/Tm	Yb/Tm	Yb/Lu
SF 0-5(a).01	3.16	5.76	5.98	2.70	1.10	6.65	4.80	6.31	1.47	10.99	4.10	9.17
SF 0-5(a).02	3.20	5.65	6.18	2.62	1.07	6.72	4.81	6.49	1.44	10.78	4.13	8.95
SF 0-5(a).03	3.12	5.50	6.01	2.64	1.08	6.90	4.45	7.05	1.31	11.70	4.20	8.87
SF 0-5(a).04	3.07	5.61	6.11	2.66	1.13	6.68	4.80	6.52	1.46	11.33	4.20	9.65
SF 0-5(a).05	3.07	5.73	6.25	2.90	1.04	7.02	4.89	6.05	1.75	8.47	4.80	8.16
SF 0-5(a).06	3.15	5.64	5.97	2.66	1.13	6.78	4.92	6.24	1.48	10.63	4.11	9.34
SF 0-5(a).07	3.13	5.52	6.22	2.84	1.13	6.96	4.73	6.32	1.44	11.00	4.06	8.40
SF 0-5(a).08	3.16	5.66	5.95	2.83	1.03	7.27	4.23	7.30	1.34	11.45	4.67	8.93
SF 0-5(a).09	3.25	5.53	5.80	2.50	1.19	6.43	4.88	5.96	1.55	10.38	3.95	8.35
SF 0-5(a).10	3.40	5.47	5.70	2.46	1.15	6.89	4.73	6.41	1.41	11.17	3.58	8.15
SF 0-5(a).11	3.20	5.60	6.33	2.77	1.14	6.41	5.06	5.75	1.69	10.21	4.48	9.68
Average	3.17	5.61	6.05	2.69	1.11	6.79	4.76	6.40	1.49	10.74	4.21	8.88
St. Deviation	0.09	0.09	0.19	0.14	0.05	0.25	0.23	0.45	0.13	0.88	0.34	0.56
2 Σ of Mean	0.06	0.06	0.12	0.08	0.03	0.15	0.14	0.27	0.08	0.53	0.20	0.34
% St. Deviation	2.95	1.66	3.17	5.17	4.42	3.74	4.83	7.04	8.97	8.16	8.04	6.28

APPENDIX B.7.4:

Trace element concentrations obtained from individual apatite phenocrysts from within the Tioga B K-bentonite layer identified as SF 0-5(b) from the Seneca Stone Quarry. Individual crystal weights could not be measured; therefore values shown have no units. Average, standard deviation, 2 sigma standard error of the mean and percent standard deviation values are shown below each analyte.

Sample Name	P	Ca	Ca/P*	Sr	Y	La	Ce	Pr	Nd	Sm
SF 0-5(b).01	2782.06	5633.39	0.94	1.93	48.78	4.82	15.83	3.00	17.92	6.89
SF 0-5(b).02	9295.17	18796.54	0.96	7.09	140.65	22.91	73.73	13.14	78.64	28.50
SF 0-5(b).03	3571.86	6977.99	0.92	2.58	58.69	9.34	29.11	5.12	30.88	10.87
SF 0-5(b).04	2541.97	4775.29	0.87	1.71	38.78	4.77	15.13	2.58	14.12	4.96
SF 0-5(b).05	9096.13	17500.75	0.89	5.53	124.37	16.50	51.06	8.88	49.46	17.85
SF 0-5(b).06	6492.98	12490.16	0.89	3.93	79.82	13.69	42.34	7.42	41.26	13.88
SF 0-5(b).07	3550.71	6958.80	0.91	2.72	51.62	6.92	21.52	3.73	21.62	6.88
SF 0-5(b).08	4490.07	8662.06	0.90	2.59	64.70	8.05	25.50	4.46	24.85	9.06
SF 0-5(b).09	9363.28	18566.51	0.92	6.85	123.15	20.80	61.35	10.72	60.26	18.81
SF 0-5(b).10	4772.02	9854.88	0.96	3.33	63.97	10.24	30.11	5.24	29.22	9.34
SF 0-5(b).11	2628.96	5006.12	0.89	1.82	33.78	5.60	17.48	3.04	16.20	5.51
SF 0-5(b).12	1954.28	4049.20	0.96	1.19	33.61	4.66	13.79	2.44	13.59	4.42
SF 0-5(b).13	3990.76	8082.82	0.94	2.34	58.37	7.13	22.23	3.91	23.78	7.94
SF 0-5(b).14	2918.71	6148.18	0.98	1.94	44.75	5.81	17.93	3.10	18.20	5.79
SF 0-5(b).15	6832.25	13733.72	0.93	4.50	102.38	13.61	41.75	7.16	41.18	13.71
SF 0-5(b).16	4918.81	10366.61	0.98	3.35	62.78	11.52	32.76	5.70	34.35	10.01
SF 0-5(b).17	2215.70	4792.05	1.01	1.41	33.64	4.44	13.32	2.33	13.80	4.48
SF 0-5(b).18	5280.49	10718.33	0.94	3.32	75.61	10.61	32.07	5.62	32.52	10.66
SF 0-5(b).19	4365.80	9372.82	1.00	2.94	67.33	8.44	25.10	4.44	27.06	8.54
SF 0-5(b).20	5619.12	11948.46	0.99	4.63	76.63	12.67	37.80	6.49	37.08	11.59
SF 0-5(b).21	4575.29	9599.78	0.98	3.15	67.78	9.67	29.33	5.06	30.09	9.45
SF 0-5(b).22	4326.91	8852.77	0.97	2.83	62.26	8.72	26.57	4.66	26.79	8.62
SF 0-5(b).23	2756.66	5470.70	0.94	1.65	37.73	5.07	15.74	2.74	15.84	5.14
SF 0-5(b).24	2355.50	4753.31	0.95	1.80	33.36	6.80	20.16	3.44	19.89	5.70
SF 0-5(b).25	1841.61	3545.10	0.91	1.18	27.03	3.86	11.57	2.02	12.19	3.81
SF 0-5(b).26	1509.26	3162.10	0.99	1.57	14.31	4.99	13.87	2.33	13.17	3.30
SF 0-5(b).27	1879.31	3630.31	0.91	1.28	24.02	4.36	13.06	2.23	13.27	3.86
SF 0-5(b).28	2087.15	3981.21	0.90	1.22	30.71	4.02	12.17	2.16	12.65	4.16
SF 0-5(b).29	2033.47	4084.36	0.95	1.54	27.36	4.77	14.23	2.48	14.38	4.28
SF 0-5(b).30	1757.58	3458.33	0.93	1.05	28.22	3.36	10.63	1.90	11.07	3.92
SF 0-5(b).31	2452.74	5152.15	0.99	1.63	37.93	4.95	15.19	2.67	15.14	5.15
SF 0-5(b).32	3077.42	6840.80	1.05	3.04	37.89	7.60	22.55	3.85	21.31	6.54
SF 0-5(b).33	1773.83	3985.24	1.06	1.12	23.39	3.93	11.76	1.97	11.38	3.43
SF 0-5(b).34	3452.74	7095.52	0.97	1.92	54.57	6.48	20.22	3.65	20.64	7.55
SF 0-5(b).35	5548.35	11415.61	0.97	3.67	83.03	10.40	32.65	5.65	33.43	11.12
SF 0-5(b).36	1358.34	2877.62	1.00	0.78	21.07	2.96	9.16	1.59	9.18	2.88
SF 0-5(b).37	618.19	1520.18	1.16	0.36	11.30	1.64	5.08	0.86	4.70	1.64
SF 0-5(b).38	2250.47	4639.61	0.97	1.48	32.14	5.01	15.35	2.65	15.48	4.90
SF 0-5(b).39	980.80	2234.53	1.08	0.61	15.69	2.03	6.19	1.09	6.46	2.11
SF 0-5(b).40	1177.20	2755.32	1.11	1.04	13.70	4.33	12.37	2.05	11.25	2.93
SF 0-5(b).41	2571.18	5421.29	0.98	1.65	42.42	5.39	16.28	2.86	16.31	5.32
		Average		51.45	51.45	7.63	23.27	4.06	23.43	7.69
		St. Deviation		30.84	30.84	4.71	14.56	2.56	14.86	5.21
		2 Σ of Mean		9.63	9.63	1.47	4.55	0.80	4.64	1.63
		% St. Deviation		59.94	59.94	61.70	62.55	63.08	63.44	67.66

APPENDIX B.7.4 continued

Sample Name	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Pb	Th	U
SF 0-5(b).01	0.23	8.37	1.51	9.42	2.17	4.71	0.67	3.45	0.43	1.41	0.58	0.72
SF 0-5(b).02	1.42	32.42	5.35	30.56	5.96	11.59	1.55	7.90	0.97	5.40	2.33	1.87
SF 0-5(b).03	0.40	12.99	2.10	12.14	2.46	4.75	0.63	3.08	0.36	3.79	0.84	0.38
SF 0-5(b).04	0.12	6.01	1.14	7.00	1.70	3.77	0.53	2.66	0.32	-1.68	0.16	0.34
SF 0-5(b).05	0.41	21.81	3.87	24.55	5.65	12.17	1.74	8.91	1.05	14.59	0.34	1.44
SF 0-5(b).06	0.34	16.63	2.77	16.24	3.42	7.23	1.03	5.26	0.63	-1.94	0.23	1.30
SF 0-5(b).07	0.18	8.63	1.48	9.34	2.15	4.72	0.65	3.26	0.39	0.49	0.09	0.55
SF 0-5(b).08	0.20	11.07	2.04	12.57	2.86	6.25	0.88	4.54	0.56	-2.84	0.15	0.72
SF 0-5(b).09	0.42	22.07	3.92	24.23	5.49	11.90	1.60	7.81	0.94	0.08	0.32	1.45
SF 0-5(b).10	0.22	11.08	1.95	12.39	2.80	6.11	0.84	4.17	0.50	-2.35	0.12	0.72
SF 0-5(b).11	0.17	6.36	1.07	6.28	1.43	3.10	0.41	1.96	0.23	-3.14	0.17	0.28
SF 0-5(b).12	0.11	5.36	0.98	6.13	1.41	3.23	0.44	2.18	0.26	-2.85	0.12	0.13
SF 0-5(b).13	0.19	9.99	1.74	11.02	2.49	5.55	0.78	4.00	0.50	-3.36	0.35	0.60
SF 0-5(b).14	0.14	7.30	1.26	8.18	1.84	4.09	0.58	2.88	0.36	-2.98	0.22	0.44
SF 0-5(b).15	0.33	17.73	3.02	19.13	4.39	9.79	1.37	6.85	0.83	-3.03	0.28	0.98
SF 0-5(b).16	0.23	12.53	1.98	12.21	2.74	5.83	0.81	3.92	0.47	-2.10	0.25	0.65
SF 0-5(b).17	0.11	5.47	0.93	6.09	1.38	3.05	0.43	2.04	0.25	-2.19	0.07	0.32
SF 0-5(b).18	0.26	13.55	2.35	15.07	3.36	7.60	1.08	5.45	0.66	-2.60	0.19	0.92
SF 0-5(b).19	0.22	10.91	1.91	12.17	2.80	6.11	0.88	4.38	0.53	-2.55	0.14	0.68
SF 0-5(b).20	0.32	14.00	2.30	14.42	3.23	7.08	0.96	4.68	0.56	36.00	0.22	0.83
SF 0-5(b).21	0.22	12.11	2.00	12.39	2.74	5.90	0.81	3.97	0.49	-2.87	0.16	0.71
SF 0-5(b).22	0.20	10.58	1.86	11.97	2.74	6.13	0.83	4.13	0.51	-1.01	0.16	0.72
SF 0-5(b).23	0.13	6.31	1.15	7.38	1.68	3.81	0.52	2.65	0.31	-1.35	0.04	0.39
SF 0-5(b).24	0.13	6.45	1.07	6.48	1.52	3.23	0.44	2.16	0.26	-0.65	0.11	0.24
SF 0-5(b).25	0.08	4.58	0.80	5.08	1.18	2.56	0.36	1.76	0.21	-1.50	0.02	0.28
SF 0-5(b).26	0.07	3.40	0.48	2.76	0.61	1.26	0.17	0.82	0.10	0.13	0.06	0.11
SF 0-5(b).27	0.10	4.65	0.77	4.70	1.05	2.16	0.31	1.48	0.18	-1.26	-0.03	0.25
SF 0-5(b).28	0.10	5.06	0.91	5.84	1.35	2.98	0.41	2.12	0.25	-1.26	-0.03	0.28
SF 0-5(b).29	0.10	5.17	0.85	5.27	1.18	2.54	0.35	1.69	0.20	-0.38	-0.01	0.32
SF 0-5(b).30	0.09	4.80	0.86	5.53	1.23	2.66	0.39	1.99	0.23	-0.77	-0.04	0.20
SF 0-5(b).31	0.12	6.32	1.09	7.03	1.61	3.57	0.48	2.44	0.29	-0.15	0.43	0.41
SF 0-5(b).32	0.14	7.49	1.23	7.45	1.63	3.46	0.46	2.23	0.28	3.46	0.22	0.47
SF 0-5(b).33	0.08	4.17	0.71	4.54	1.02	2.30	0.30	1.53	0.18	-1.15	0.11	0.29
SF 0-5(b).34	0.18	9.50	1.67	10.57	2.36	5.12	0.74	3.78	0.46	-0.85	0.17	0.56
SF 0-5(b).35	0.27	13.73	2.47	15.56	3.57	7.99	1.15	5.67	0.67	-0.29	0.19	0.78
SF 0-5(b).36	0.07	3.55	0.62	3.95	0.90	2.00	0.28	1.45	0.17	-1.22	0.07	0.24
SF 0-5(b).37	0.04	1.91	0.34	2.25	0.49	1.08	0.16	0.80	0.09	-0.77	0.09	0.10
SF 0-5(b).38	0.11	5.81	0.98	6.06	1.37	2.95	0.40	2.02	0.24	-1.02	0.07	0.36
SF 0-5(b).39	0.05	2.62	0.44	2.87	0.67	1.44	0.21	1.02	0.12	-0.65	0.04	0.13
SF 0-5(b).40	0.07	3.02	0.45	2.71	0.58	1.16	0.16	0.84	0.10	-0.13	0.10	0.08
SF 0-5(b).41	0.13	6.83	1.19	7.64	1.72	3.85	0.53	2.55	0.32	-3.80	0.14	0.45
Average	0.21	9.33	1.60	9.93	2.22	4.80	0.67	3.33	0.40	0.26	0.23	0.55
St. Deviation	0.22	6.16	1.05	6.29	1.35	2.85	0.40	2.00	0.24	6.50	0.38	0.40
2 Σ of Mean	0.07	1.92	0.33	1.96	0.42	0.89	0.12	0.62	0.08	2.03	0.12	0.13
% St. Deviation	105.49	66.02	65.44	63.29	60.79	59.49	59.52	60.08	60.19	2498.60	166.36	72.74

APPENDIX B.7.5:

Percent relative standard deviation values for each element analyzed during ICP-MS analysis of individual apatite phenocrysts from within the Tioga B K-bentonite layer identified as SF 0-5(b) from the Seneca Stone Quarry. These percent values are generated during the sixteen passes with five replicate analyses per pass for each individual apatite crystal analyzed.

Sample Name	P	Ca	Sr	Y	La	Ce	Pr	Nd	Sm	Eu
SF 0-5(b).01	11.26	14.50	3.66	3.85	1.97	2.63	2.23	5.92	1.27	5.44
SF 0-5(b).02	3.93	2.94	2.13	0.90	0.86	2.19	1.24	2.84	2.00	2.33
SF 0-5(b).03	4.50	1.59	3.92	3.06	1.77	1.71	0.48	6.01	1.84	2.61
SF 0-5(b).04	4.13	4.04	3.28	4.57	1.97	2.19	1.87	3.88	1.75	5.48
SF 0-5(b).05	3.04	2.28	2.13	0.98	2.33	1.59	2.03	2.68	2.30	1.43
SF 0-5(b).06	2.85	2.48	2.51	2.66	3.01	2.22	1.96	5.80	5.13	2.02
SF 0-5(b).07	2.75	3.70	0.87	3.51	3.44	2.56	2.03	6.86	3.35	7.16
SF 0-5(b).08	2.24	2.30	3.25	3.35	2.67	2.31	2.25	0.84	3.29	2.84
SF 0-5(b).09	2.34	1.80	1.51	1.48	4.70	3.64	0.92	2.22	3.83	2.43
SF 0-5(b).10	3.91	4.35	1.91	3.06	2.42	3.50	1.35	5.48	1.38	7.59
SF 0-5(b).11	5.60	5.15	3.86	3.21	4.11	2.08	2.61	4.87	1.63	4.56
SF 0-5(b).12	3.69	6.11	2.54	3.95	2.48	3.67	2.16	7.66	6.29	7.90
SF 0-5(b).13	3.02	3.62	2.89	0.97	2.45	2.14	2.95	3.83	1.54	3.51
SF 0-5(b).14	3.53	4.15	2.38	2.26	3.06	2.14	3.13	6.65	4.02	6.62
SF 0-5(b).15	1.25	0.37	0.48	3.00	2.26	1.89	1.81	5.44	5.31	6.94
SF 0-5(b).16	2.57	2.43	3.30	2.06	1.71	1.98	2.18	3.93	3.19	6.34
SF 0-5(b).17	4.83	6.95	2.11	2.19	4.58	2.50	2.99	6.42	5.40	8.90
SF 0-5(b).18	1.59	1.03	1.93	4.02	2.43	3.21	2.18	2.44	3.03	5.47
SF 0-5(b).19	0.79	2.24	1.41	1.06	1.60	2.17	2.56	5.78	2.40	2.35
SF 0-5(b).20	2.47	4.01	1.37	2.19	2.64	1.31	1.25	10.28	3.27	5.82
SF 0-5(b).21	4.63	3.35	2.74	2.24	1.74	1.61	1.91	2.59	4.78	6.60
SF 0-5(b).22	3.01	1.81	1.76	1.96	2.51	2.34	1.94	4.12	4.73	2.19
SF 0-5(b).23	4.72	4.77	1.45	3.31	3.38	1.50	2.58	4.21	2.93	3.38
SF 0-5(b).24	2.16	3.68	2.82	3.17	1.84	1.42	2.88	2.29	1.72	6.53
SF 0-5(b).25	4.27	5.91	1.45	2.52	2.02	3.22	2.72	6.73	3.69	6.92
SF 0-5(b).26	4.65	4.74	4.72	2.28	2.79	4.17	2.24	6.73	6.19	5.10
SF 0-5(b).27	4.40	8.26	1.87	3.38	2.76	1.16	2.21	4.17	3.82	5.12
SF 0-5(b).28	2.68	3.32	1.87	3.82	2.71	1.95	1.04	5.27	3.87	1.95
SF 0-5(b).29	5.02	5.12	2.11	1.24	5.39	2.00	2.79	4.22	4.55	9.04
SF 0-5(b).30	4.31	3.62	4.39	2.40	5.06	3.27	2.98	3.07	5.08	12.10
SF 0-5(b).31	7.28	7.28	2.63	3.23	1.30	1.76	3.91	7.27	3.16	7.18
SF 0-5(b).32	3.35	4.84	1.23	0.58	0.96	0.86	1.22	3.61	2.33	6.50
SF 0-5(b).33	4.24	5.30	2.05	2.27	2.74	0.73	2.34	8.20	3.12	4.41
SF 0-5(b).34	5.77	4.93	1.78	2.35	0.91	1.95	1.72	3.08	2.42	7.65
SF 0-5(b).35	3.16	3.81	1.80	2.14	1.98	0.97	1.73	1.57	1.81	4.56
SF 0-5(b).36	5.62	5.49	4.34	4.57	1.30	3.02	1.82	4.60	4.78	4.99
SF 0-5(b).37	6.63	7.13	4.79	4.14	3.11	2.67	2.64	8.64	6.58	15.27
SF 0-5(b).38	3.48	4.35	1.54	2.31	1.83	1.78	2.40	5.23	2.85	5.34
SF 0-5(b).39	5.82	4.42	4.80	1.52	0.53	4.13	2.92	5.34	2.54	9.04
SF 0-5(b).40	5.13	9.16	1.79	1.57	1.36	1.85	2.01	7.58	3.18	10.36
SF 0-5(b).41	2.93	2.88	1.98	1.96	1.50	2.23	2.73	9.44	2.01	9.52

APPENDIX B.7.5 continued

Sample Name	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Pb	Th	U
SF 0-5(b).01	1.64	1.71	1.80	2.89	2.70	3.40	2.97	4.41	8.87	10.44	4.00
SF 0-5(b).02	2.14	3.49	3.07	4.57	4.42	3.37	4.59	5.07	1.42	4.57	2.47
SF 0-5(b).03	1.02	1.74	4.20	2.01	2.75	4.69	2.25	3.56	3.31	2.96	2.11
SF 0-5(b).04	1.89	1.91	3.98	2.60	2.57	2.94	3.43	4.36	6.38	16.88	2.92
SF 0-5(b).05	1.64	3.15	2.52	3.94	2.60	2.88	2.95	4.62	2.48	6.39	1.94
SF 0-5(b).06	4.34	2.76	2.50	1.59	2.82	3.34	1.50	3.66	6.06	5.58	3.36
SF 0-5(b).07	4.62	2.03	3.43	3.09	3.15	3.86	3.34	2.37	26.72	17.15	5.17
SF 0-5(b).08	3.85	3.17	3.59	2.08	4.24	1.66	1.78	3.42	1.49	11.11	2.31
SF 0-5(b).09	2.61	1.94	2.18	1.87	2.47	3.05	3.71	5.37	133.50	10.75	3.03
SF 0-5(b).10	3.43	1.18	5.13	2.41	3.54	1.57	4.47	4.76	4.62	25.06	4.62
SF 0-5(b).11	3.86	2.81	1.02	0.47	5.85	1.95	3.12	3.23	2.18	9.00	7.86
SF 0-5(b).12	1.96	3.70	2.65	3.39	3.46	3.01	2.98	2.08	1.76	21.24	11.23
SF 0-5(b).13	3.61	1.10	2.40	2.11	2.51	1.18	3.13	1.43	1.91	11.74	2.08
SF 0-5(b).14	1.09	2.53	2.12	3.89	7.50	2.99	5.24	4.25	3.31	4.25	4.72
SF 0-5(b).15	2.90	2.78	3.99	3.23	2.75	4.26	4.84	3.60	1.36	7.33	5.15
SF 0-5(b).16	2.81	1.50	1.46	2.66	3.82	1.44	3.43	3.16	2.37	12.91	3.56
SF 0-5(b).17	2.05	3.29	3.25	4.40	6.68	3.99	5.07	4.18	2.88	26.71	6.14
SF 0-5(b).18	4.30	1.63	4.52	1.68	4.13	2.51	1.73	3.19	4.22	9.98	4.54
SF 0-5(b).19	3.98	2.18	4.90	1.54	2.78	3.70	1.22	3.83	3.12	21.23	7.00
SF 0-5(b).20	2.33	3.43	3.43	4.22	4.72	3.04	3.97	4.70	9.59	14.42	4.00
SF 0-5(b).21	2.01	1.45	3.85	1.70	4.03	1.88	2.68	1.61	4.56	12.40	3.83
SF 0-5(b).22	2.00	2.20	3.40	3.17	4.74	2.82	1.36	3.45	2.48	21.75	3.27
SF 0-5(b).23	2.86	3.30	3.68	2.71	4.00	2.82	4.06	6.03	1.61	48.40	4.71
SF 0-5(b).24	1.97	2.44	3.48	1.60	1.85	1.82	3.63	4.28	4.95	25.22	3.95
SF 0-5(b).25	3.65	1.24	2.77	2.79	3.83	3.32	4.51	4.55	1.76	101.42	5.03
SF 0-5(b).26	6.50	1.84	2.23	2.85	9.24	4.83	4.26	2.71	20.07	34.42	6.97
SF 0-5(b).27	3.75	1.00	2.14	1.94	3.14	3.27	3.33	3.31	1.34	28.80	6.02
SF 0-5(b).28	2.53	2.34	2.10	2.29	2.59	1.69	2.65	3.47	2.47	61.95	5.56
SF 0-5(b).29	1.93	2.43	3.25	1.78	4.54	3.43	4.99	3.42	6.30	120.90	5.54
SF 0-5(b).30	3.94	3.62	2.21	5.74	2.64	1.78	5.22	5.18	4.80	52.28	4.62
SF 0-5(b).31	1.80	1.00	2.68	2.23	5.71	3.21	3.12	2.54	22.50	5.82	6.09
SF 0-5(b).32	1.87	3.23	2.24	1.38	0.90	2.43	4.62	2.92	2.01	20.80	4.10
SF 0-5(b).33	1.67	3.07	4.23	2.98	4.91	2.42	3.16	8.04	1.64	20.14	2.67
SF 0-5(b).34	3.35	2.98	3.62	1.16	3.93	2.73	3.90	4.01	3.24	6.70	4.77
SF 0-5(b).35	3.54	1.31	2.62	2.04	3.71	2.61	1.63	3.13	15.60	12.90	3.92
SF 0-5(b).36	4.29	1.44	1.40	1.78	5.81	3.29	3.42	4.92	1.56	19.19	3.07
SF 0-5(b).37	4.46	3.93	7.09	2.94	9.14	4.42	2.26	9.92	5.01	15.37	4.03
SF 0-5(b).38	2.09	3.66	1.86	3.78	1.28	3.95	3.19	1.30	3.82	16.00	2.55
SF 0-5(b).39	3.96	2.90	3.21	4.38	8.50	4.16	1.63	9.52	3.03	36.79	3.19
SF 0-5(b).40	2.93	2.82	5.99	2.43	7.04	4.99	6.37	8.34	31.27	18.85	5.90
SF 0-5(b).41	6.11	4.23	3.65	5.47	6.71	2.85	3.88	1.87	2.56	16.71	6.67

APPENDIX B.7.6:

Rare earth element ratios derived from trace element concentration values found in Appendix B.7.4 for individual apatite phenocrysts from the Tioga B K-bentonite layer identified as SF 0-5(b) from the Seneca Stone Quarry. Mean, standard deviation, 2 Sigma standard error of the mean, and percent standard deviation values for trace elements are below each ratio.

Sample Name	Ce/La	Ce/Pr	Nd/Pr	Nd/Sm	Gd/Sm	Gd/Tb
SF 0-5(b).01	3.28	5.27	5.97	2.60	1.22	5.56
SF 0-5(b).02	3.22	5.61	5.98	2.76	1.14	6.06
SF 0-5(b).03	3.12	5.68	6.03	2.84	1.19	6.19
SF 0-5(b).04	3.17	5.87	5.48	2.85	1.21	5.30
SF 0-5(b).05	3.09	5.75	5.57	2.77	1.22	5.64
SF 0-5(b).06	3.09	5.70	5.56	2.97	1.20	6.00
SF 0-5(b).07	3.11	5.77	5.80	3.14	1.25	5.81
SF 0-5(b).08	3.17	5.72	5.58	2.74	1.22	5.42
SF 0-5(b).09	2.95	5.72	5.62	3.20	1.17	5.63
SF 0-5(b).10	2.94	5.74	5.57	3.13	1.19	5.69
SF 0-5(b).11	3.12	5.75	5.33	2.94	1.15	5.95
SF 0-5(b).12	2.96	5.65	5.57	3.08	1.21	5.48
SF 0-5(b).13	3.12	5.69	6.09	2.99	1.26	5.73
SF 0-5(b).14	3.09	5.78	5.86	3.14	1.26	5.81
SF 0-5(b).15	3.07	5.83	5.76	3.00	1.29	5.88
SF 0-5(b).16	2.84	5.75	6.03	3.43	1.25	6.33
SF 0-5(b).17	3.00	5.73	5.93	3.08	1.22	5.86
SF 0-5(b).18	3.02	5.71	5.79	3.05	1.27	5.76
SF 0-5(b).19	2.97	5.65	6.09	3.17	1.28	5.72
SF 0-5(b).20	2.98	5.82	5.71	3.20	1.21	6.08
SF 0-5(b).21	3.03	5.79	5.94	3.18	1.28	6.04
SF 0-5(b).22	3.05	5.70	5.75	3.11	1.23	5.68
SF 0-5(b).23	3.10	5.75	5.79	3.08	1.23	5.48
SF 0-5(b).24	2.96	5.86	5.78	3.49	1.13	6.01
SF 0-5(b).25	3.00	5.73	6.04	3.20	1.20	5.73
SF 0-5(b).26	2.78	5.95	5.65	3.99	1.03	7.06
SF 0-5(b).27	3.00	5.87	5.96	3.44	1.21	6.01
SF 0-5(b).28	3.03	5.62	5.85	3.04	1.22	5.57
SF 0-5(b).29	2.98	5.73	5.79	3.36	1.21	6.05
SF 0-5(b).30	3.16	5.60	5.83	2.83	1.23	5.58
SF 0-5(b).31	3.07	5.69	5.67	2.94	1.23	5.81
SF 0-5(b).32	2.97	5.86	5.53	3.26	1.15	6.07
SF 0-5(b).33	2.99	5.96	5.77	3.32	1.22	5.83
SF 0-5(b).34	3.12	5.54	5.65	2.73	1.26	5.70
SF 0-5(b).35	3.14	5.77	5.91	3.01	1.23	5.56
SF 0-5(b).36	3.09	5.77	5.79	3.19	1.23	5.74
SF 0-5(b).37	3.10	5.89	5.46	2.87	1.16	5.63
SF 0-5(b).38	3.06	5.78	5.83	3.16	1.19	5.90
SF 0-5(b).39	3.05	5.68	5.93	3.06	1.24	5.93
SF 0-5(b).40	2.85	6.04	5.49	3.84	1.03	6.77
SF 0-5(b).41	3.02	5.70	5.71	3.07	1.28	5.75
Average	3.05	5.74	5.77	3.10	1.21	5.85
St. Deviation	0.10	0.13	0.19	0.27	0.06	0.33
2 Σ of Mean	0.03	0.04	0.06	0.09	0.02	0.10
% St. Deviation	3.26	2.20	3.29	8.84	4.68	5.65

APPENDIX B.7.6 continued

Sample Name	Dy/Tb	Dy/Ho	Er/Ho	Er/Tm	Yb/Tm	Yb/Lu
SF 0-5(b).01	6.25	4.34	2.17	7.01	5.13	8.08
SF 0-5(b).02	5.71	5.13	1.95	7.46	5.09	8.14
SF 0-5(b).03	5.78	4.93	1.93	7.51	4.87	8.54
SF 0-5(b).04	6.16	4.12	2.22	7.06	4.99	8.37
SF 0-5(b).05	6.35	4.35	2.15	6.98	5.11	8.46
SF 0-5(b).06	5.86	4.75	2.11	7.04	5.12	8.33
SF 0-5(b).07	6.29	4.34	2.20	7.21	4.98	8.38
SF 0-5(b).08	6.15	4.39	2.18	7.06	5.14	8.13
SF 0-5(b).09	6.18	4.41	2.17	7.43	4.88	8.27
SF 0-5(b).10	6.36	4.43	2.18	7.28	4.97	8.36
SF 0-5(b).11	5.88	4.39	2.17	7.59	4.80	8.43
SF 0-5(b).12	6.27	4.34	2.29	7.41	5.01	8.29
SF 0-5(b).13	6.32	4.42	2.22	7.09	5.11	8.05
SF 0-5(b).14	6.51	4.44	2.22	7.10	5.00	8.06
SF 0-5(b).15	6.34	4.36	2.23	7.17	5.02	8.27
SF 0-5(b).16	6.17	4.45	2.12	7.19	4.84	8.41
SF 0-5(b).17	6.52	4.40	2.20	7.08	4.73	8.08
SF 0-5(b).18	6.41	4.49	2.26	7.05	5.06	8.31
SF 0-5(b).19	6.38	4.34	2.18	6.98	5.00	8.25
SF 0-5(b).20	6.26	4.47	2.19	7.38	4.88	8.32
SF 0-5(b).21	6.18	4.53	2.16	7.25	4.88	8.09
SF 0-5(b).22	6.42	4.37	2.24	7.36	4.97	8.11
SF 0-5(b).23	6.41	4.38	2.26	7.34	5.11	8.48
SF 0-5(b).24	6.04	4.26	2.13	7.31	4.87	8.37
SF 0-5(b).25	6.34	4.29	2.16	7.18	4.94	8.26
SF 0-5(b).26	5.73	4.56	2.08	7.46	4.84	8.29
SF 0-5(b).27	6.07	4.47	2.05	6.97	4.79	8.18
SF 0-5(b).28	6.44	4.34	2.21	7.25	5.15	8.38
SF 0-5(b).29	6.17	4.46	2.15	7.28	4.83	8.44
SF 0-5(b).30	6.44	4.48	2.15	6.87	5.16	8.66
SF 0-5(b).31	6.46	4.37	2.22	7.40	5.06	8.51
SF 0-5(b).32	6.04	4.56	2.12	7.54	4.86	7.89
SF 0-5(b).33	6.36	4.45	2.26	7.60	5.04	8.50
SF 0-5(b).34	6.34	4.48	2.17	6.94	5.12	8.29
SF 0-5(b).35	6.30	4.36	2.24	6.97	4.94	8.43
SF 0-5(b).36	6.38	4.38	2.22	7.12	5.14	8.65
SF 0-5(b).37	6.65	4.62	2.21	6.91	5.12	8.52
SF 0-5(b).38	6.16	4.42	2.15	7.40	5.07	8.49
SF 0-5(b).39	6.48	4.30	2.17	6.78	4.80	8.32
SF 0-5(b).40	6.08	4.64	1.99	7.10	5.11	8.55
SF 0-5(b).41	6.43	4.44	2.24	7.30	4.84	8.00
Average	6.25	4.45	2.17	7.21	4.98	8.32
St. Deviation	0.22	0.17	0.08	0.21	0.12	0.18
2 Σ of Mean	0.07	0.05	0.02	0.07	0.04	0.06
% St. Deviation	3.53	3.90	3.65	2.91	2.48	2.18

APPENDIX B.7.7:

Trace element concentrations obtained from ICP-MS analysis of individual apatite phenocrysts from within the Tioga B K-bentonite layer identified as SF 5-8(Clr) from the Seneca Stone Quarry. Individual crystal weights could not be measured; therefore values shown have no units. Average, standard deviation, 2 sigma standard error of the mean and percent standard deviation values are shown below each analyte.

Sample Name	P	Ca	Ca/P*	Sr	Y	La	Ce	Pr	Nd	Sm
SF 5-8(Clr).01	5650.64	11908.62	0.98	6.27	70.58	16.59	51.85	9.27	54.90	20.59
SF 5-8(Clr).02	3448.88	6936.36	0.94	3.35	39.79	10.29	32.39	5.76	34.38	13.16
SF 5-8(Clr).03	5545.75	11781.35	0.99	4.86	66.70	15.12	47.42	8.46	50.66	18.94
SF 5-8(Clr).04	9140.40	18449.39	0.94	9.97	74.18	28.04	88.85	16.06	94.25	34.88
SF 5-8(Clr).05	6286.59	12801.62	0.95	6.20	83.74	17.59	56.28	9.92	58.40	22.29
SF 5-8(Clr).06	5356.65	10658.99	0.93	4.53	59.45	16.34	49.34	8.84	52.18	19.05
SF 5-8(Clr).07	3565.06	7340.66	0.96	3.96	42.85	10.32	33.85	5.95	35.36	13.16
SF 5-8(Clr).08	7489.57	14986.94	0.93	6.74	92.38	20.92	65.50	11.32	64.98	24.31
SF 5-8(Clr).09	5421.19	10873.98	0.93	6.90	44.70	17.67	57.34	10.17	60.77	22.85
SF 5-8(Clr).10	3219.96	6840.61	0.99	2.89	37.58	9.84	29.71	5.38	31.92	11.66
SF 5-8(Clr).11	7476.56	15176.12	0.94	7.04	89.65	22.81	70.96	12.38	71.59	26.55
SF 5-8(Clr).12	13020.37	26038.15	0.93	12.37	145.13	44.91	134.20	23.19	136.03	44.95
SF 5-8(Clr).13	8543.38	17186.85	0.94	7.74	98.56	26.78	81.59	14.52	87.26	31.89
SF 5-8(Clr).14	6655.25	13670.29	0.96	5.81	86.07	22.41	67.39	12.08	74.35	25.61
SF 5-8(Clr).15	5723.42	12032.59	0.98	6.89	49.57	19.75	58.13	10.25	64.18	21.11
SF 5-8(Clr).16	3377.57	6887.47	0.95	3.76	25.75	11.39	34.65	6.30	39.54	13.47
SF 5-8(Clr).17	9084.72	18485.68	0.95	8.46	84.48	30.89	93.09	16.76	101.45	36.29
SF 5-8(Clr).18	4481.93	9311.25	0.97	3.66	52.05	14.09	40.50	7.29	46.90	15.67
SF 5-8(Clr).19	3396.24	6734.06	0.94	2.71	40.93	11.12	33.44	5.93	36.69	13.13
SF 5-8(Clr).20	3852.14	7502.99	0.92	3.34	45.35	12.32	38.37	6.74	40.44	15.05
SF 5-8(Clr).21	4153.29	8380.18	0.95	3.92	61.67	12.12	37.60	6.82	42.59	14.96
SF 5-8(Clr).22	6935.55	13922.02	0.95	6.74	85.81	22.51	70.26	12.33	72.82	27.10
SF 5-8(Clr).23	19028.78	39383.88	0.98	19.13	225.15	58.06	180.87	32.02	194.36	70.97
SF 5-8(Clr).24	7203.38	14329.92	0.94	6.34	88.94	22.81	70.10	12.37	74.89	27.17
SF 5-8(Clr).25	2075.86	4015.67	0.91	2.05	20.40	7.08	22.12	3.97	23.29	9.10
SF 5-8(Clr).26	3765.09	7466.08	0.94	3.55	45.71	12.01	36.62	6.49	40.31	14.69
SF 5-8(Clr).27	6473.26	13112.77	0.96	7.14	82.33	19.52	60.96	10.98	65.96	24.69
		Average		71.83	71.83	19.75	60.87	10.80	64.83	23.45
		St. Deviation		40.90	40.90	11.12	34.14	6.00	35.86	12.75
		2 Σ of Mean		15.74	15.74	4.28	13.14	2.31	13.80	4.91
		% St. Deviation		56.94	56.94	56.31	56.09	55.54	55.31	54.37

APPENDIX B.7.7 continued

Sample Name	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Pb	Th	U
SF 5-8(Clr).01	1.32	24.09	3.52	17.29	2.87	4.76	0.49	2.21	0.25	0.27	5.49	0.93
SF 5-8(Clr).02	0.79	15.40	2.27	10.44	1.68	2.47	0.23	0.90	0.10	-0.21	2.07	0.58
SF 5-8(Clr).03	0.99	22.32	3.28	16.20	2.74	4.73	0.51	2.30	0.26	-1.17	3.21	0.79
SF 5-8(Clr).04	1.98	38.29	5.11	21.26	3.02	4.59	0.50	2.36	0.29	-1.04	3.65	1.43
SF 5-8(Clr).05	1.27	26.95	4.01	20.03	3.37	5.36	0.57	2.28	0.25	-1.46	2.53	0.88
SF 5-8(Clr).06	0.89	22.98	3.32	15.80	2.46	3.67	0.33	1.33	0.13	-1.18	1.64	0.58
SF 5-8(Clr).07	0.88	15.76	2.24	10.70	1.69	2.40	0.23	0.88	0.10	-0.05	3.27	0.47
SF 5-8(Clr).08	1.24	29.28	4.45	22.66	3.87	6.50	0.71	3.07	0.34	-0.84	1.39	0.86
SF 5-8(Clr).09	1.75	25.00	3.21	13.08	1.71	2.23	0.20	0.83	0.09	9.06	4.19	1.03
SF 5-8(Clr).10	0.65	14.46	2.06	10.01	1.55	2.22	0.21	0.81	0.09	0.56	1.87	0.43
SF 5-8(Clr).11	1.29	32.37	4.71	22.15	3.60	5.22	0.49	1.87	0.21	-1.17	3.14	0.90
SF 5-8(Clr).12	2.60	54.37	7.72	37.53	6.26	10.01	0.98	4.30	0.49	-0.88	6.77	1.36
SF 5-8(Clr).13	1.78	38.92	5.59	26.30	4.14	6.13	0.53	2.04	0.21	-1.54	5.05	1.24
SF 5-8(Clr).14	1.30	32.00	4.62	21.91	3.46	5.15	0.47	1.83	0.19	-1.69	1.88	1.06
SF 5-8(Clr).15	1.49	23.98	3.22	13.95	2.06	2.81	0.26	1.04	0.12	-1.03	4.92	0.94
SF 5-8(Clr).16	1.01	15.38	2.01	7.99	1.10	1.41	0.11	0.45	0.05	-2.57	2.94	0.62
SF 5-8(Clr).17	1.73	42.34	5.59	24.02	3.28	4.17	0.36	1.44	0.16	-1.26	2.46	1.11
SF 5-8(Clr).18	0.72	19.47	2.82	13.66	2.18	3.13	0.29	1.17	0.12	-2.34	0.75	0.43
SF 5-8(Clr).19	0.61	15.82	2.24	10.65	1.66	2.35	0.22	0.86	0.09	-5.32	1.64	0.36
SF 5-8(Clr).20	0.80	17.93	2.53	11.79	1.79	2.55	0.23	0.92	0.10	-5.33	2.16	0.59
SF 5-8(Clr).21	0.90	18.37	2.80	14.45	2.51	4.06	0.45	1.75	0.19	-4.51	1.32	0.53
SF 5-8(Clr).22	1.43	32.38	4.65	21.89	3.42	4.96	0.45	1.76	0.19	-4.79	3.38	1.08
SF 5-8(Clr).23	3.74	85.14	12.20	58.04	9.05	13.24	1.22	4.77	0.51	0.99	6.80	2.50
SF 5-8(Clr).24	1.17	31.82	4.78	22.65	3.61	5.25	0.50	2.00	0.21	-4.48	1.90	0.74
SF 5-8(Clr).25	0.64	10.39	1.42	6.20	0.85	1.11	0.10	0.37	0.04	-5.22	1.69	0.38
SF 5-8(Clr).26	0.77	17.59	2.49	11.74	1.86	2.69	0.25	1.00	0.10	2.37	1.31	0.56
SF 5-8(Clr).27	1.63	29.40	4.21	19.69	3.21	4.61	0.44	1.78	0.19	-3.48	4.36	1.14
Average	1.31	27.86	3.96	18.60	2.93	4.36	0.42	1.72	0.19	-1.42	3.03	0.87
St. Deviation	0.68	15.25	2.17	10.40	1.67	2.58	0.25	1.05	0.12	2.93	1.65	0.45
2 Σ of Mean	0.26	5.87	0.84	4.00	0.64	0.99	0.10	0.40	0.05	1.13	0.64	0.17
% St. Deviation	51.97	54.74	54.82	55.95	57.15	59.12	59.58	61.15	62.38	-206.36	54.62	51.26

APPENDIX B.7.8:

Percent relative standard deviation values for each element analyzed during ICP-MS analysis of individual apatite phenocrysts from within the Tioga B K-bentonite layer identified as SF 5-8(Clr) from the Seneca Stone Quarry. These percent values are generated during the sixteen passes with five replicate analyses per pass for each individual apatite crystal analyzed.

Sample Name	P	Ca	Sr	Y	La	Ce	Pr	Nd	Sm	Eu
SF 5-8(Clr).01	4.05	5.14	1.77	2.24	1.35	1.51	1.06	1.68	1.28	3.35
SF 5-8(Clr).02	2.07	2.80	2.17	1.63	3.85	3.05	5.90	2.91	3.10	2.76
SF 5-8(Clr).03	1.98	2.32	3.29	3.07	2.22	2.70	1.38	4.20	3.52	0.44
SF 5-8(Clr).04	3.70	4.82	2.82	2.91	0.96	1.42	1.47	3.29	1.23	2.01
SF 5-8(Clr).05	0.59	2.15	1.29	1.46	1.23	1.59	2.31	5.85	2.05	2.76
SF 5-8(Clr).06	2.25	3.71	2.32	3.84	1.33	2.69	2.18	5.68	2.86	3.75
SF 5-8(Clr).07	4.02	3.89	2.09	1.33	1.24	3.25	1.65	3.19	3.57	2.66
SF 5-8(Clr).08	1.53	0.81	1.35	2.19	1.48	3.23	1.83	2.48	2.98	2.07
SF 5-8(Clr).09	3.33	4.14	1.28	1.02	2.23	1.45	1.28	4.92	2.87	2.38
SF 5-8(Clr).10	4.70	2.44	1.72	2.15	2.62	3.13	1.49	1.90	2.97	3.78
SF 5-8(Clr).11	3.04	2.35	1.35	2.69	2.39	0.58	1.62	1.55	1.55	1.37
SF 5-8(Clr).12	1.63	1.14	0.82	2.07	1.18	1.80	1.53	2.18	2.45	1.72
SF 5-8(Clr).13	1.57	1.79	1.07	1.21	2.05	1.96	1.52	3.31	1.21	4.92
SF 5-8(Clr).14	2.18	2.68	0.91	1.70	1.45	2.00	1.56	3.24	2.35	2.06
SF 5-8(Clr).15	2.42	2.17	1.76	1.39	1.44	2.16	2.10	3.57	1.96	2.69
SF 5-8(Clr).16	2.30	2.91	1.14	2.86	1.97	1.49	2.61	3.88	2.71	3.10
SF 5-8(Clr).17	1.22	2.52	2.25	1.65	1.44	1.41	1.86	2.53	3.10	3.07
SF 5-8(Clr).18	2.28	1.92	2.90	1.98	3.36	1.69	1.12	4.02	1.51	4.51
SF 5-8(Clr).19	5.08	3.76	2.69	3.86	1.80	3.46	0.73	4.96	3.87	5.15
SF 5-8(Clr).20	5.15	3.93	4.29	3.90	1.69	2.57	2.70	3.45	1.01	2.64
SF 5-8(Clr).21	3.47	2.66	2.76	2.01	2.38	4.19	2.02	5.97	1.32	4.18
SF 5-8(Clr).22	3.21	4.02	2.75	3.49	1.48	1.49	1.76	3.16	3.18	4.23
SF 5-8(Clr).23	1.53	2.61	0.95	2.24	1.56	2.75	1.85	3.51	2.86	2.49
SF 5-8(Clr).24	2.56	0.66	1.95	1.34	2.79	3.30	2.73	4.45	4.16	2.23
SF 5-8(Clr).25	4.69	4.69	1.63	1.37	3.21	1.23	4.97	7.34	2.14	4.05
SF 5-8(Clr).26	3.88	4.32	1.61	1.81	2.58	3.04	3.40	6.05	2.29	2.94
SF 5-8(Clr).27	4.13	2.43	2.38	2.82	1.41	1.14	2.00	5.12	1.50	3.70

APPENDIX B.7.8 continued

Sample Name	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Pb	Th	U
SF 5-8(Clr).01	1.93	4.27	2.87	5.67	6.74	5.62	2.92	4.87	58.03	3.53	5.39
SF 5-8(Clr).02	2.45	2.98	4.51	3.83	6.36	7.38	7.50	3.83	65.55	3.69	4.48
SF 5-8(Clr).03	1.63	2.58	4.25	2.33	2.35	4.70	4.17	6.36	8.50	5.80	4.29
SF 5-8(Clr).04	2.08	1.99	4.13	3.02	4.20	3.72	5.14	5.51	13.58	3.17	3.32
SF 5-8(Clr).05	3.54	1.09	1.21	3.07	4.59	2.53	4.39	2.39	6.07	6.17	22.20
SF 5-8(Clr).06	1.77	0.26	1.07	2.90	3.27	4.00	5.15	5.77	7.99	5.46	2.04
SF 5-8(Clr).07	2.24	0.45	4.07	1.94	5.06	7.75	4.90	2.61	303.82	3.60	2.69
SF 5-8(Clr).08	3.34	0.79	1.14	1.92	1.40	3.08	2.77	3.73	13.18	5.07	1.69
SF 5-8(Clr).09	2.26	0.99	3.85	2.35	6.73	4.07	2.56	11.43	2.09	4.14	4.44
SF 5-8(Clr).10	1.99	2.08	3.89	1.15	4.77	6.10	5.57	6.31	26.68	3.34	2.55
SF 5-8(Clr).11	1.49	2.17	1.46	1.06	3.56	4.80	5.14	7.11	6.33	7.19	3.44
SF 5-8(Clr).12	1.40	2.08	2.61	2.36	5.19	3.84	3.26	6.85	11.08	3.23	4.81
SF 5-8(Clr).13	1.24	2.64	1.61	1.97	12.11	1.48	5.04	6.80	6.50	5.68	4.48
SF 5-8(Clr).14	2.55	2.34	2.52	1.05	2.77	3.14	2.53	7.82	6.62	4.38	2.43
SF 5-8(Clr).15	1.74	1.11	2.37	3.55	7.12	6.99	9.31	6.81	8.99	4.15	1.05
SF 5-8(Clr).16	1.21	0.87	2.11	4.14	8.05	8.65	7.33	11.01	1.98	3.29	3.99
SF 5-8(Clr).17	0.99	2.49	2.24	2.89	2.25	3.23	4.75	3.05	5.53	3.93	3.51
SF 5-8(Clr).18	5.24	1.66	3.89	2.39	2.35	4.61	1.72	2.77	1.59	5.93	3.36
SF 5-8(Clr).19	2.72	1.60	2.69	1.51	3.78	4.72	3.76	4.61	1.15	4.68	4.68
SF 5-8(Clr).20	3.08	3.16	5.28	1.89	3.47	5.84	8.08	2.80	1.10	3.70	36.71
SF 5-8(Clr).21	2.45	1.07	3.33	2.67	3.66	2.82	3.52	7.04	1.88	5.04	4.63
SF 5-8(Clr).22	1.39	2.48	1.69	3.10	5.22	2.75	4.85	5.84	2.37	1.93	2.60
SF 5-8(Clr).23	1.28	1.13	1.77	0.91	3.39	2.68	2.53	1.50	15.45	2.55	2.89
SF 5-8(Clr).24	5.60	3.02	1.31	2.42	1.73	2.24	3.86	5.11	1.33	3.51	3.98
SF 5-8(Clr).25	3.32	2.77	4.87	6.53	9.47	4.82	4.18	13.47	0.97	5.00	4.34
SF 5-8(Clr).26	1.75	4.33	7.01	3.12	5.33	1.58	4.50	3.30	9.67	5.36	4.86
SF 5-8(Clr).27	4.68	1.31	2.18	1.66	2.44	3.40	0.85	4.61	2.00	4.03	1.51

APPENDIX B.7.9:

Rare earth element ratios derived from values found in Appendix B.7.7. for individual apatite phenocrysts from layer SF 5-8(Clr) from the Seneca Stone Quarry. Mean, standard deviation, 2 Sigma standard error of the mean, and percent standard deviation values for trace elements are below each ratio.

Sample Name	Ce/La	Ce/Pr	Nd/Pr	Nd/Sm	Gd/Sm	Gd/Tb	Dy/Tb	Dy/Ho	Er/Ho	Er/Tm	Yb/Tm	Yb/Lu
SF 5-8(Clr).01	3.12	5.59	5.92	2.67	1.17	6.84	4.91	6.03	1.66	9.63	4.48	8.94
SF 5-8(Clr).02	3.15	5.63	5.97	2.61	1.17	6.79	4.60	6.24	1.48	10.76	3.92	9.35
SF 5-8(Clr).03	3.14	5.61	5.99	2.68	1.18	6.81	4.94	5.91	1.72	9.30	4.53	8.80
SF 5-8(Clr).04	3.17	5.53	5.87	2.70	1.10	7.50	4.16	7.03	1.52	9.23	4.75	8.07
SF 5-8(Clr).05	3.20	5.67	5.88	2.62	1.21	6.72	4.99	5.94	1.59	9.47	4.03	9.06
SF 5-8(Clr).06	3.02	5.58	5.90	2.74	1.21	6.93	4.76	6.42	1.49	10.95	3.98	9.97
SF 5-8(Clr).07	3.28	5.69	5.95	2.69	1.20	7.05	4.79	6.34	1.42	10.61	3.89	8.77
SF 5-8(Clr).08	3.13	5.79	5.74	2.67	1.20	6.59	5.10	5.86	1.68	9.22	4.36	8.91
SF 5-8(Clr).09	3.25	5.64	5.97	2.66	1.09	7.79	4.08	7.64	1.30	11.08	4.14	9.07
SF 5-8(Clr).10	3.02	5.52	5.93	2.74	1.24	7.02	4.86	6.46	1.43	10.44	3.83	9.10
SF 5-8(Clr).11	3.11	5.73	5.78	2.70	1.22	6.87	4.71	6.15	1.45	10.54	3.77	9.06
SF 5-8(Clr).12	2.99	5.79	5.87	3.03	1.21	7.05	4.86	6.00	1.60	10.23	4.39	8.75
SF 5-8(Clr).13	3.05	5.62	6.01	2.74	1.22	6.97	4.71	6.36	1.48	11.57	3.86	9.75
SF 5-8(Clr).14	3.01	5.58	6.15	2.90	1.25	6.92	4.74	6.34	1.49	10.86	3.86	9.65
SF 5-8(Clr).15	2.94	5.67	6.26	3.04	1.14	7.44	4.33	6.76	1.36	10.88	4.03	8.46
SF 5-8(Clr).16	3.04	5.50	6.27	2.94	1.14	7.65	3.98	7.26	1.28	12.25	3.94	8.63
SF 5-8(Clr).17	3.01	5.56	6.05	2.80	1.17	7.58	4.30	7.33	1.27	11.75	4.06	8.95
SF 5-8(Clr).18	2.87	5.56	6.43	2.99	1.24	6.91	4.85	6.28	1.44	10.88	4.06	9.91
SF 5-8(Clr).19	3.01	5.64	6.19	2.79	1.20	7.06	4.75	6.43	1.42	10.74	3.95	9.63
SF 5-8(Clr).20	3.12	5.69	6.00	2.69	1.19	7.08	4.65	6.59	1.42	10.89	3.93	9.52
SF 5-8(Clr).21	3.10	5.52	6.25	2.85	1.23	6.57	5.17	5.75	1.61	9.09	3.92	9.14
SF 5-8(Clr).22	3.12	5.70	5.91	2.69	1.19	6.97	4.71	6.40	1.45	11.01	3.90	9.15
SF 5-8(Clr).23	3.12	5.65	6.07	2.74	1.20	6.98	4.76	6.41	1.46	10.87	3.92	9.37
SF 5-8(Clr).24	3.07	5.66	6.05	2.76	1.17	6.66	4.74	6.27	1.45	10.40	3.97	9.63
SF 5-8(Clr).25	3.12	5.58	5.87	2.56	1.14	7.34	4.38	7.27	1.30	11.62	3.89	8.67
SF 5-8(Clr).26	3.05	5.64	6.21	2.74	1.20	7.07	4.72	6.30	1.44	10.77	3.99	9.90
SF 5-8(Clr).27	3.12	5.55	6.01	2.67	1.19	6.98	4.68	6.14	1.44	10.53	4.05	9.39
Average	3.09	5.62	6.02	2.75	1.19	7.04	4.67	6.44	1.47	10.58	4.05	9.17
St. Deviation	0.09	0.08	0.16	0.13	0.04	0.32	0.29	0.48	0.12	0.81	0.24	0.48
2 Σ of Mean	0.03	0.03	0.06	0.05	0.02	0.12	0.11	0.19	0.05	0.31	0.09	0.18
% St. Deviation	2.88	1.38	2.74	4.58	3.32	4.51	6.30	7.51	7.99	7.69	5.94	5.18

APPENDIX B.7.10:

Trace element concentrations obtained from ICP-MS analysis of individual apatite phenocrysts from within the Tioga B K-bentonite layer identified as SF 5-8(a) from the Seneca Stone Quarry. Individual crystal weights could not be measured; therefore values shown have no units. Average, standard deviation, 2 sigma standard error of the mean and percent standard deviation values are shown below each analyte.

Sample Name	P	Ca	Ca/P*	Sr	Y	La	Ce	Pr	Nd	Sm
SF 5-8(a).01	6269.45	12477.98	0.94	6.67	71.94	18.25	59.25	10.56	64.40	23.87
SF 5-8(a).02	3011.68	5789.72	0.91	2.61	35.66	8.98	28.11	4.97	29.87	11.17
SF 5-8(a).03	5650.04	11125.53	0.93	5.72	51.73	18.35	56.70	10.15	62.40	22.27
SF 5-8(a).04	6473.11	12866.31	0.94	6.25	79.09	19.82	62.04	11.05	66.88	24.39
SF 5-8(a).05	3325.82	6391.42	0.91	3.92	27.38	11.21	34.84	6.14	37.05	13.19
SF 5-8(a).06	3824.24	7466.10	0.92	3.39	56.14	10.74	34.28	6.16	35.27	13.78
SF 5-8(a).07	6261.07	12315.11	0.93	5.08	77.13	19.54	60.43	10.81	64.95	23.55
SF 5-8(a).08	3006.35	5783.54	0.91	3.07	23.77	11.01	32.85	5.75	34.41	11.72
SF 5-8(a).09	3966.91	6536.06	0.78	2.58	70.19	12.79	44.66	8.48	50.55	20.50
SF 5-8(a).10	9107.76	17942.76	0.93	9.40	110.60	45.77	145.27	26.49	160.32	57.04
SF 5-8(a).11	6696.09	12475.36	0.88	5.05	120.32	29.07	93.07	16.83	104.86	38.59
SF 5-8(a).12	4939.95	8238.58	0.79	3.33	84.30	19.66	69.57	12.90	103.20	30.10
SF 5-8(a).13	5783.13	9582.20	0.78	5.42	100.03	21.93	78.81	14.23	84.56	34.73
SF 5-8(a).14	11589.21	24402.62	1.00	9.54	163.33	32.67	96.75	17.57	109.83	38.27
		Average		76.54	76.54	19.98	64.04	11.58	72.04	25.94
		St. Deviation		38.42	38.42	10.13	31.90	5.85	37.09	12.89
		2 Σ of Mean		20.54	20.54	5.41	17.05	3.13	19.83	6.89
		% St. Deviation		50.20	50.20	50.69	49.81	50.51	51.49	49.69

Sample Name	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Pb	Th	U
SF 5-8(a).01	1.80	27.11	4.06	19.22	3.00	4.30	0.39	1.58	0.18	6.03	5.47	1.14
SF 5-8(a).02	0.75	12.45	1.87	8.85	1.42	2.10	0.19	0.83	0.09	5.33	1.49	0.50
SF 5-8(a).03	1.45	24.74	3.52	15.26	2.12	2.79	0.22	0.93	0.12	4.39	3.16	0.92
SF 5-8(a).04	1.40	27.58	4.24	19.90	3.20	4.70	0.43	1.75	0.20	5.46	3.48	0.82
SF 5-8(a).05	1.21	13.84	1.89	7.81	1.11	1.53	0.13	0.55	0.08	6.39	4.46	0.70
SF 5-8(a).06	0.90	16.02	2.58	13.41	2.35	3.84	0.39	1.68	0.19	6.22	2.50	0.59
SF 5-8(a).07	1.18	25.86	4.02	19.32	3.10	4.70	0.44	1.83	0.20	6.36	2.62	0.87
SF 5-8(a).08	0.84	12.08	1.66	6.88	0.96	1.34	0.11	0.51	0.06	6.44	2.33	0.50
SF 5-8(a).09	0.96	25.58	3.80	18.83	2.96	4.46	0.42	1.66	0.19	0.85	1.63	0.21
SF 5-8(a).10	3.52	62.64	8.24	33.96	4.54	5.48	0.45	1.64	0.19	-0.20	11.60	1.11
SF 5-8(a).11	1.90	47.65	6.63	31.84	4.90	6.95	0.61	2.17	0.22	-0.36	5.42	0.61
SF 5-8(a).12	1.44	35.96	4.94	22.54	3.36	4.60	0.38	1.28	0.14	-0.33	2.91	0.41
SF 5-8(a).13	2.35	41.31	5.55	25.62	3.89	5.39	0.48	1.74	0.19	0.28	10.92	0.73
SF 5-8(a).14	2.04	48.04	7.20	38.64	7.11	12.77	1.47	6.67	0.78	-1.01	4.21	1.79
Average	1.55	30.06	4.30	20.15	3.14	4.64	0.44	1.77	0.20	3.28	4.44	0.78
St. Deviation	0.74	15.27	2.04	9.74	1.64	2.83	0.33	1.50	0.18	3.13	3.14	0.39
2 Σ of Mean	0.40	8.16	1.09	5.21	0.88	1.51	0.18	0.80	0.09	1.67	1.68	0.21
% St. Deviation	47.83	50.79	47.37	48.35	52.13	60.96	75.55	84.48	86.64	95.42	70.71	49.98

APPENDIX B.7.11:

Percent relative standard deviation values for each element analyzed during ICP-MS analysis of individual apatite phenocrysts from within the Tioga B K-bentonite layer SF 5-8(a) from the Seneca Stone Quarry. These percent values are generated during the sixteen passes with five replicate analyses per pass for each individual apatite crystal analyzed.

Sample Name	P	Ca	Sr	Y	La	Ce	Pr	Nd	Sm	Eu
SF 5-8(a).01	2.76	1.89	2.74	1.73	2.51	1.82	2.60	3.94	0.69	2.85
SF 5-8(a).02	6.19	3.98	1.39	2.02	0.84	1.56	1.82	3.19	2.07	1.33
SF 5-8(a).03	4.31	2.94	2.77	3.77	0.91	3.05	1.42	4.30	1.05	3.39
SF 5-8(a).04	2.27	3.11	2.09	1.11	2.57	3.39	0.61	3.53	1.72	2.79
SF 5-8(a).05	2.71	2.02	2.69	3.15	2.95	1.09	1.66	6.05	3.75	5.76
SF 5-8(a).06	3.25	3.14	4.42	4.42	2.03	1.59	1.71	2.36	1.44	3.07
SF 5-8(a).07	2.61	3.02	1.18	1.75	1.01	1.71	1.57	1.84	2.40	3.02
SF 5-8(a).08	3.18	2.52	3.37	2.17	1.48	1.85	2.00	4.13	2.71	2.57
SF 5-8(a).09	4.05	6.84	4.36	2.55	3.51	4.97	3.09	7.18	2.86	5.54
SF 5-8(a).10	5.76	3.88	2.21	4.24	2.52	2.12	2.26	2.59	1.39	3.75
SF 5-8(a).11	4.02	4.69	3.59	4.40	4.04	4.01	2.18	3.40	3.01	2.67
SF 5-8(a).12	2.27	8.03	5.55	4.34	3.17	1.93	3.02	83.30	2.39	2.44
SF 5-8(a).13	2.80	5.51	3.95	4.32	5.14	3.44	4.90	5.39	2.74	6.47
SF 5-8(a).14	2.88	3.11	2.49	2.84	1.90	2.56	1.39	1.42	1.77	3.05

Sample Name	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Pb	Th	U
SF 5-8(a).01	3.36	2.47	3.15	2.56	1.68	4.63	1.69	4.16	1.66	3.62	3.96
SF 5-8(a).02	3.22	2.15	1.63	2.15	4.74	6.98	3.04	3.16	2.03	3.86	4.48
SF 5-8(a).03	2.28	2.05	1.80	2.75	4.03	3.88	6.04	8.07	3.89	5.51	4.49
SF 5-8(a).04	2.80	1.81	1.37	3.37	2.18	2.38	0.78	3.77	1.42	4.30	4.03
SF 5-8(a).05	3.68	1.82	2.16	1.97	4.17	6.14	5.90	3.99	1.50	3.56	3.93
SF 5-8(a).06	2.24	2.38	4.89	4.77	4.46	1.52	2.87	4.27	1.71	2.68	8.64
SF 5-8(a).07	4.37	1.48	2.49	2.40	3.44	3.66	4.13	4.04	0.98	3.71	4.87
SF 5-8(a).08	2.73	2.07	4.26	0.93	4.06	3.87	4.96	6.56	0.58	4.39	6.34
SF 5-8(a).09	3.63	3.82	5.75	5.18	3.90	5.69	6.85	9.00	7.63	10.32	3.49
SF 5-8(a).10	2.21	2.08	3.64	0.67	3.59	5.54	5.88	6.66	26.39	139.70	4.70
SF 5-8(a).11	3.13	2.81	3.57	2.93	2.56	3.63	6.59	7.16	5.85	7.94	2.92
SF 5-8(a).12	4.65	3.33	3.12	2.12	3.63	7.73	7.00	7.94	11.53	5.63	8.07
SF 5-8(a).13	3.80	3.35	6.38	3.49	7.09	9.11	3.37	6.18	20.31	5.83	15.15
SF 5-8(a).14	1.04	2.21	1.74	2.05	1.44	1.65	2.79	2.26	36.88	2.43	2.73

APPENDIX B.7.12:

Rare earth element ratios derived from trace element concentration values found in Appendix B.7.10 for individual apatite phenocrysts from the Tioga B K-bentonite layer identified as SF 5-8(a) from the Seneca Stone Quarry. Mean, standard deviation, 2 Sigma standard error of the mean, and percent standard deviation values for trace elements are below each ratio.

Sample Name	Ce/La	Ce/Pr	Nd/Pr	Nd/Sm	Gd/Sm	Gd/Tb
SF 5-8(a).01	3.25	5.61	6.10	2.70	1.14	6.68
SF 5-8(a).02	3.13	5.66	6.01	2.67	1.12	6.65
SF 5-8(a).03	3.09	5.59	6.15	2.80	1.11	7.03
SF 5-8(a).04	3.13	5.62	6.05	2.74	1.13	6.50
SF 5-8(a).05	3.11	5.67	6.04	2.81	1.05	7.31
SF 5-8(a).06	3.19	5.57	5.73	2.56	1.16	6.22
SF 5-8(a).07	3.09	5.59	6.01	2.76	1.10	6.42
SF 5-8(a).08	2.98	5.71	5.98	2.94	1.03	7.27
SF 5-8(a).09	3.49	5.26	5.96	2.47	1.25	6.74
SF 5-8(a).10	3.17	5.48	6.05	2.81	1.10	7.61
SF 5-8(a).11	3.20	5.53	6.23	2.72	1.23	7.19
SF 5-8(a).12	3.54	5.39	8.00	3.43	1.19	7.28
SF 5-8(a).13	3.59	5.54	5.94	2.43	1.19	7.45
SF 5-8(a).14	2.96	5.51	6.25	2.87	1.26	6.67
Average	3.21	5.55	6.18	2.76	1.15	6.93
St. Deviation	0.20	0.12	0.54	0.24	0.07	0.43
2 Σ of Mean	0.11	0.06	0.29	0.13	0.04	0.23
% St. Deviation	6.12	2.11	8.73	8.65	6.15	6.16

Sample Name	Dy/Tb	Dy/Ho	Er/Ho	Er/Tm	Yb/Tm	Yb/Lu
SF 5-8(a).01	4.74	6.40	1.43	11.02	4.03	8.73
SF 5-8(a).02	4.73	6.21	1.48	10.78	4.28	8.97
SF 5-8(a).03	4.34	7.20	1.32	12.49	4.16	8.07
SF 5-8(a).04	4.69	6.21	1.47	10.92	4.06	8.74
SF 5-8(a).05	4.13	7.01	1.37	11.70	4.23	7.33
SF 5-8(a).06	5.20	5.70	1.63	9.84	4.30	8.71
SF 5-8(a).07	4.80	6.24	1.52	10.81	4.22	9.22
SF 5-8(a).08	4.14	7.19	1.40	12.26	4.68	8.54
SF 5-8(a).09	4.96	6.36	1.51	10.58	3.94	8.70
SF 5-8(a).10	4.12	7.48	1.21	12.19	3.64	8.46
SF 5-8(a).11	4.80	6.50	1.42	11.46	3.57	9.84
SF 5-8(a).12	4.56	6.71	1.37	12.20	3.41	9.15
SF 5-8(a).13	4.62	6.59	1.39	11.25	3.63	9.26
SF 5-8(a).14	5.36	5.43	1.80	8.69	4.54	8.52
Average	4.66	6.52	1.45	11.16	4.05	8.73
St. Deviation	0.38	0.57	0.14	1.04	0.37	0.59
2 Σ of Mean	0.20	0.31	0.08	0.56	0.20	0.32
% St. Deviation	8.20	8.80	9.75	9.32	9.24	6.77

APPENDIX B.7.13:

Trace element concentrations obtained from ICP-MS analysis of individual apatite phenocrysts from within the Tioga B K-bentonite layer identified as SF 5-8(b) from the Seneca Stone Quarry. Individual crystal weights could not be measured; therefore values shown have no units. Average, standard deviation, 2 sigma standard error of the mean and percent standard deviation values are shown below each analyte

Sample Name	P	Ca	Ca/P*	Sr	Y	La	Ce	Pr	Nd	Sm
SF 5-8(b).01	3523.95	7242.31	0.96	1.95	57.12	6.55	21.30	3.74	21.68	7.76
SF 5-8(b).02	4261.52	8640.09	0.94	3.26	47.84	10.10	30.12	5.21	28.46	8.53
SF 5-8(b).03	3096.68	6436.89	0.97	2.03	46.98	5.71	18.01	3.20	17.88	6.27
SF 5-8(b).04	6112.64	12292.63	0.94	3.94	90.61	11.76	36.68	6.33	35.77	12.10
SF 5-8(b).05	4364.13	8806.38	0.94	2.86	66.48	7.64	24.81	4.38	24.75	9.07
SF 5-8(b).06	4485.18	9242.53	0.96	2.56	68.84	8.33	25.44	4.62	26.54	9.32
SF 5-8(b).07	2387.57	4681.08	0.91	1.53	37.79	4.83	15.03	2.60	14.53	5.11
SF 5-8(b).08	1925.41	4667.87	1.15	13.28	28.63	3.42	10.84	1.92	11.55	3.91
SF 5-8(b).09	2473.95	5016.75	0.94	1.46	35.74	4.46	13.80	2.52	14.40	4.81
SF 5-8(b).10	3776.52	7979.12	1.00	2.30	55.42	6.91	21.11	3.87	23.42	7.54
SF 5-8(b).11	4778.26	9661.92	0.96	2.59	71.63	8.60	27.90	4.90	28.28	10.07
SF 5-8(b).12	2548.11	5250.27	0.97	1.27	34.65	4.75	14.61	2.62	15.23	5.00
SF 5-8(b).13	6757.17	15083.63	1.06	5.32	92.46	12.34	36.40	6.59	39.13	13.12
SF 5-8(b).14	5192.90	12838.10	1.17	4.55	77.33	9.99	30.05	5.45	32.99	10.42
SF 5-8(b).15	4781.40	9719.82	0.96	3.62	67.45	12.04	36.52	6.22	36.47	10.62
SF 5-8(b).16	4620.13	10039.24	1.03	3.23	69.76	8.82	25.97	4.91	29.26	9.66
SF 5-8(b).17	3250.85	6407.88	0.93	2.08	44.47	6.41	19.14	3.32	19.23	6.21
SF 5-8(b).18	4363.20	8853.41	0.96	2.72	67.61	8.14	25.18	4.46	25.93	8.46
SF 5-8(b).19	2891.84	5849.17	0.96	1.59	43.86	5.49	16.59	2.94	16.83	5.67
SF 5-8(b).20	7003.70	14070.72	0.95	4.03	97.07	12.55	38.53	7.00	40.26	13.60
SF 5-8(b).21	4071.48	8216.51	0.95	2.15	64.05	7.56	24.17	4.24	23.55	8.37
SF 5-8(b).22	3237.32	6385.99	0.93	1.24	47.62	5.50	18.09	3.26	18.19	7.00
SF 5-8(b).23	5398.50	10565.44	0.93	3.16	82.32	9.93	31.60	5.51	31.21	10.76
SF 5-8(b).24	3264.41	6326.74	0.92	1.66	56.49	6.73	21.63	3.73	20.19	7.58
SF 5-8(b).25	5542.67	10927.42	0.93	3.19	84.09	10.27	32.19	5.68	31.96	11.43
SF 5-8(b).26	3761.50	7687.21	0.97	2.87	63.25	7.57	23.46	4.16	23.83	8.24
SF 5-8(b).27	3323.27	6589.17	0.94	1.76	50.62	6.27	19.74	3.40	19.19	6.72
		Average		61.12	61.12	7.88	24.40	4.33	24.84	8.42
		St. Deviation		18.62	18.62	2.56	7.68	1.36	7.95	2.57
		2 Σ of Mean		7.17	7.17	0.99	2.96	0.52	3.06	0.99
		% St. Deviation		30.46	30.46	32.55	31.48	31.41	32.01	30.50

APPENDIX B.7.13 continued

Sample Name	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Pb	Th	U
SF 5-8(b).01	0.16	9.77	1.69	10.89	2.41	5.35	0.78	3.87	0.46	-0.59	0.41	0.47
SF 5-8(b).02	0.18	10.10	1.62	9.67	2.12	4.57	0.62	2.97	0.37	-0.87	0.20	0.63
SF 5-8(b).03	0.14	7.92	1.42	9.15	2.04	4.65	0.65	3.33	0.40	-0.42	0.13	0.49
SF 5-8(b).04	0.29	15.25	2.61	16.52	3.76	8.42	1.20	6.15	0.73	-1.29	0.23	0.92
SF 5-8(b).05	0.21	11.28	2.01	12.63	2.76	6.11	0.90	4.53	0.56	-0.98	0.18	0.60
SF 5-8(b).06	0.21	11.38	2.05	13.05	2.95	6.51	0.93	4.82	0.59	-0.92	0.16	0.73
SF 5-8(b).07	0.13	6.57	1.16	7.39	1.73	3.73	0.54	2.75	0.33	-0.42	0.12	0.33
SF 5-8(b).08	0.09	4.62	0.86	5.57	1.24	2.76	0.40	2.04	0.25	5.54	0.17	0.30
SF 5-8(b).09	0.11	5.96	1.07	7.07	1.59	3.62	0.51	2.57	0.32	6.46	0.09	0.39
SF 5-8(b).10	0.18	9.62	1.66	10.52	2.36	5.22	0.74	3.72	0.45	0.62	0.22	0.64
SF 5-8(b).11	0.23	12.92	2.26	14.22	3.23	7.27	1.04	5.22	0.64	-1.38	0.21	0.97
SF 5-8(b).12	0.12	6.35	1.13	7.02	1.61	3.71	0.48	2.55	0.31	-3.72	0.11	0.39
SF 5-8(b).13	0.31	17.22	2.99	19.37	4.36	9.67	1.40	7.11	0.87	-1.18	0.18	1.01
SF 5-8(b).14	0.26	13.45	2.39	15.78	3.62	7.92	1.11	5.60	0.68	12.32	0.21	0.80
SF 5-8(b).15	0.24	13.17	2.16	13.04	2.90	6.37	0.84	4.13	0.49	-2.15	0.25	0.93
SF 5-8(b).16	0.23	12.71	2.20	13.77	3.07	6.96	0.97	4.90	0.60	8.82	0.17	0.82
SF 5-8(b).17	0.16	7.81	1.37	8.90	2.02	4.43	0.61	3.09	0.37	0.55	0.07	0.46
SF 5-8(b).18	0.21	11.29	1.97	12.59	2.85	6.40	0.91	4.44	0.54	-2.71	0.26	0.71
SF 5-8(b).19	0.14	7.17	1.28	8.00	1.85	4.09	0.60	2.88	0.35	-2.44	0.15	0.42
SF 5-8(b).20	0.31	17.28	2.88	18.20	4.12	9.19	1.35	6.71	0.83	-2.96	0.20	1.04
SF 5-8(b).21	0.19	10.81	1.84	11.86	2.69	5.95	0.86	4.30	0.53	-2.58	0.21	0.73
SF 5-8(b).22	0.13	8.86	1.52	9.87	2.08	4.54	0.64	3.33	0.39	-4.66	0.10	0.59
SF 5-8(b).23	0.25	13.52	2.40	15.74	3.56	8.10	1.12	5.56	0.67	-4.29	0.20	0.87
SF 5-8(b).24	0.17	9.85	1.67	10.83	2.45	5.32	0.78	4.00	0.47	-5.11	0.15	0.69
SF 5-8(b).25	0.26	14.54	2.55	16.33	3.69	8.09	1.13	5.89	0.71	-4.47	0.19	0.78
SF 5-8(b).26	0.19	10.76	1.86	11.70	2.68	5.83	0.84	4.13	0.51	0.06	0.16	0.72
SF 5-8(b).27	0.16	8.64	1.55	10.03	2.20	4.91	0.70	3.58	0.43	-4.84	0.12	0.52
Average	0.19	10.70	1.86	11.84	2.67	5.91	0.84	4.23	0.51	-0.50	0.18	0.66
St. Deviation	0.06	3.33	0.56	3.59	0.82	1.82	0.26	1.33	0.16	4.21	0.07	0.21
2 Σ of Mean	0.02	1.28	0.22	1.38	0.31	0.70	0.10	0.51	0.06	1.62	0.03	0.08
% St. Deviation	31.39	31.10	30.17	30.30	30.65	30.80	31.49	31.54	32.07	-834.07	37.11	32.20

APPENDIX B.7.14:

Percent relative standard deviation values for each element analyzed during ICP-MS analysis of individual apatite phenocrysts from within the Tioga B K-bentonite layer SF 5-8(b) from the Seneca Stone Quarry. These percent values are generated during the sixteen passes with five replicate analyses per pass for each individual apatite crystal analyzed

Sample Name	P	Ca	Sr	Y	La	Ce	Pr	Nd	Sm	Eu
SF 5-8(b).01	2.67	4.51	1.36	2.45	1.62	1.90	2.16	4.37	3.13	7.57
SF 5-8(b).02	3.01	3.29	2.48	2.73	1.71	2.55	1.88	4.36	2.61	2.96
SF 5-8(b).03	1.09	2.73	2.45	3.66	3.04	1.67	1.67	4.73	4.02	7.52
SF 5-8(b).04	1.42	3.74	2.27	2.04	1.39	1.31	0.98	2.32	3.85	5.34
SF 5-8(b).05	1.85	3.32	4.08	3.79	3.41	3.92	1.17	1.63	4.78	4.91
SF 5-8(b).06	1.94	1.13	3.18	2.46	2.26	1.34	2.14	2.40	4.12	3.27
SF 5-8(b).07	1.89	1.93	1.86	3.06	3.29	3.38	1.74	9.04	1.90	12.44
SF 5-8(b).08	4.02	4.74	2.46	3.38	3.02	4.06	2.17	3.75	1.18	6.54
SF 5-8(b).09	3.27	3.46	1.90	2.84	1.59	3.11	3.43	6.32	4.27	13.73
SF 5-8(b).10	4.30	4.23	4.51	3.95	2.54	3.77	2.15	3.31	2.17	6.35
SF 5-8(b).11	2.44	3.31	1.60	2.41	1.12	2.10	3.25	4.93	2.02	2.97
SF 5-8(b).12	3.23	3.64	3.57	2.77	5.46	4.60	3.90	4.22	5.03	8.59
SF 5-8(b).13	2.09	1.31	2.28	2.71	3.30	0.80	2.05	3.99	2.49	8.58
SF 5-8(b).14	2.70	3.60	1.74	1.69	2.15	2.25	1.30	3.01	2.92	5.06
SF 5-8(b).15	2.60	3.80	1.44	1.92	3.12	2.66	3.22	4.66	4.06	4.29
SF 5-8(b).16	1.29	2.36	5.00	2.83	2.14	3.72	3.35	3.58	3.70	5.23
SF 5-8(b).17	3.85	5.27	1.64	2.70	1.82	3.63	2.13	3.86	7.02	6.27
SF 5-8(b).18	1.32	3.44	2.91	2.20	1.47	3.31	0.85	10.46	3.83	5.03
SF 5-8(b).19	3.18	4.04	3.23	2.32	2.13	3.27	2.60	4.52	1.26	11.25
SF 5-8(b).20	2.30	0.66	1.32	2.11	1.58	1.28	1.78	3.60	2.43	3.26
SF 5-8(b).21	2.43	3.01	2.94	3.45	1.64	2.07	2.89	5.84	2.63	6.08
SF 5-8(b).22	1.36	3.15	3.46	2.57	3.95	3.75	2.34	4.96	4.98	8.90
SF 5-8(b).23	2.96	4.34	1.56	2.11	2.01	2.98	2.44	2.90	5.17	5.20
SF 5-8(b).24	2.44	3.59	4.60	4.34	2.91	2.80	3.59	3.75	1.17	9.89
SF 5-8(b).25	4.94	3.22	3.53	3.28	1.43	2.03	1.78	3.02	3.73	3.75
SF 5-8(b).26	1.18	5.01	2.72	2.64	2.31	1.48	3.48	5.30	3.41	8.12
SF 5-8(b).27	3.23	3.81	2.30	2.93	2.94	2.52	0.91	3.22	4.12	7.71

APPENDIX B.7.14 continued

Sample Name	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Pb	Th	U
SF 5-8(b).01	2.87	1.55	3.34	3.92	4.98	3.02	4.11	1.25	29.02	9.05	3.96
SF 5-8(b).02	5.04	2.60	6.25	3.19	1.90	3.94	2.85	4.61	9.21	13.23	3.00
SF 5-8(b).03	3.38	3.34	2.50	1.03	2.41	1.11	2.82	3.86	13.77	13.89	4.60
SF 5-8(b).04	2.40	1.61	0.84	2.99	2.69	2.54	1.36	1.93	9.28	8.93	2.77
SF 5-8(b).05	4.36	2.30	3.01	1.51	3.09	1.58	2.16	2.62	3.84	19.02	4.24
SF 5-8(b).06	5.19	1.53	3.10	2.16	2.57	3.35	2.97	3.14	10.86	12.83	3.58
SF 5-8(b).07	3.92	1.93	1.38	1.80	3.23	2.19	7.38	5.29	29.48	7.75	7.77
SF 5-8(b).08	4.43	2.27	3.60	4.21	2.84	3.21	2.55	3.90	0.90	15.37	5.32
SF 5-8(b).09	3.00	3.08	5.28	3.12	1.78	1.23	1.15	3.64	3.07	28.51	6.83
SF 5-8(b).10	4.16	3.33	4.59	4.73	3.66	4.79	3.06	4.51	73.87	12.87	4.36
SF 5-8(b).11	3.48	2.85	3.20	3.86	1.95	2.07	3.64	4.87	32.06	19.99	1.23
SF 5-8(b).12	1.38	3.72	4.16	5.52	5.18	3.21	6.86	4.17	4.20	11.54	3.20
SF 5-8(b).13	3.97	4.02	3.71	3.21	2.57	2.41	4.11	2.29	28.41	22.65	1.23
SF 5-8(b).14	5.97	2.84	4.45	3.40	3.55	4.81	5.25	2.21	4.77	10.20	5.09
SF 5-8(b).15	3.54	4.05	3.30	1.02	4.32	2.03	3.28	3.10	11.81	8.71	2.71
SF 5-8(b).16	4.05	3.36	2.16	2.40	1.30	2.92	2.62	3.94	4.46	17.39	2.55
SF 5-8(b).17	4.31	2.76	2.65	4.48	3.42	2.07	3.52	2.94	61.64	30.57	4.76
SF 5-8(b).18	1.35	1.74	1.53	2.17	5.16	2.47	2.46	1.64	3.00	12.23	3.43
SF 5-8(b).19	2.47	1.20	5.29	2.60	3.35	2.72	3.62	3.18	2.65	6.29	4.61
SF 5-8(b).20	2.20	4.04	2.80	2.98	3.74	2.90	2.75	3.54	3.01	11.75	4.36
SF 5-8(b).21	2.38	2.18	4.95	3.97	4.06	1.29	4.30	2.63	4.13	4.85	3.23
SF 5-8(b).22	4.23	2.74	3.83	3.77	1.86	2.14	2.42	2.32	1.97	13.53	4.74
SF 5-8(b).23	6.02	3.28	4.06	4.04	3.90	1.65	3.52	3.16	1.52	6.49	5.57
SF 5-8(b).24	3.38	0.87	3.17	1.59	2.58	1.45	1.64	1.56	1.22	17.67	3.40
SF 5-8(b).25	3.86	3.18	3.75	6.02	3.62	2.89	4.95	2.40	2.01	15.19	3.63
SF 5-8(b).26	5.31	2.07	3.67	3.30	5.04	2.84	1.19	5.77	340.36	11.66	3.33
SF 5-8(b).27	2.73	2.80	2.08	2.08	2.18	2.01	1.50	2.50	1.09	17.59	5.15

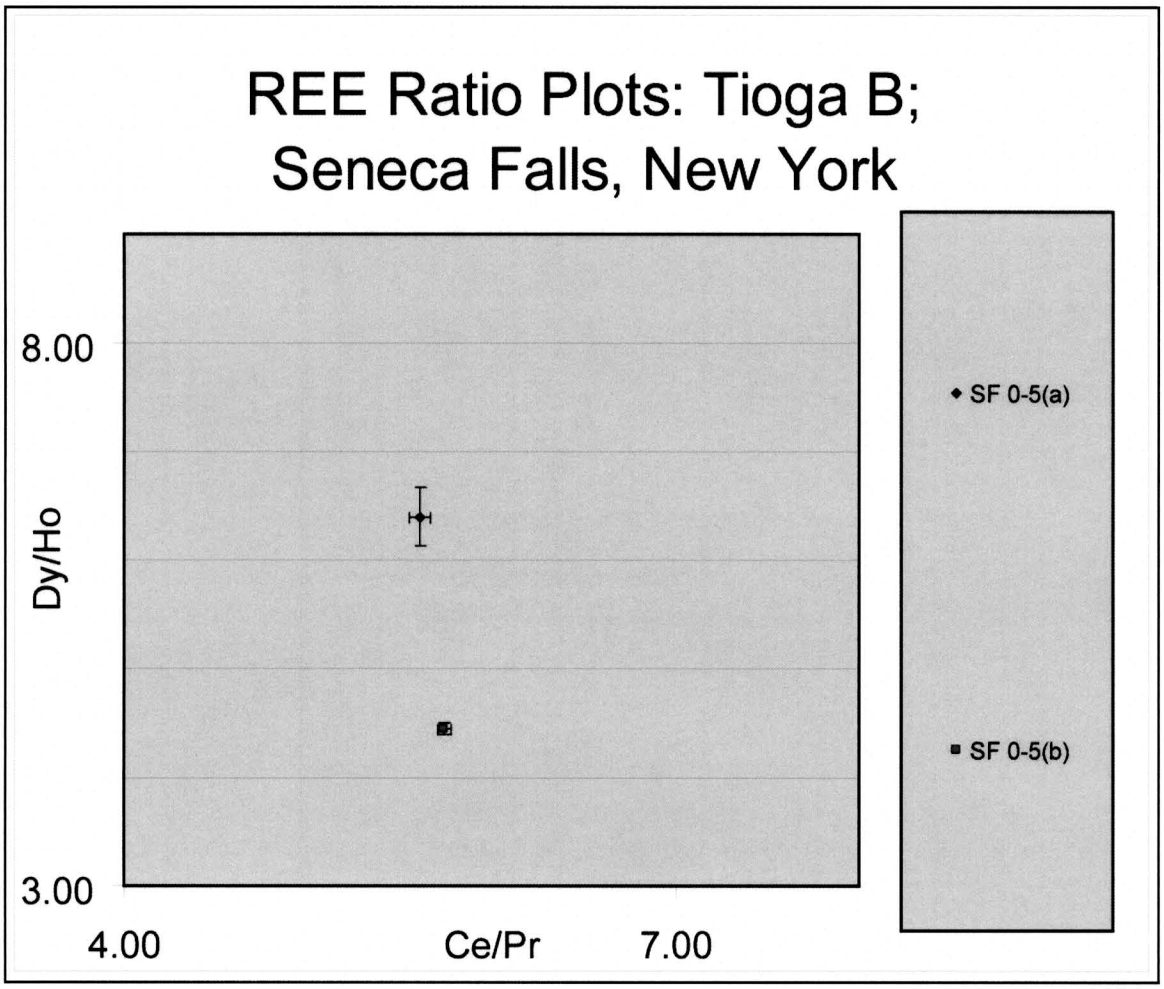
APPENDIX B.7.15:

Rare earth element ratios derived from values found in Appendix B.7.13. for individual apatite phenocrysts from layer SF 5-8(b) from the Seneca Stone Quarry. Mean, standard deviation, 2 Sigma standard error of the mean, and percent standard deviation values for trace elements are below each ratio.

Sample Name	Ce/La	Ce/Pr	Nd/Pr	Nd/Sm	Gd/Sm	Gd/Tb	Dy/Tb	Dy/Ho	Er/Ho	Er/Tm	Yb/Tm	Yb/Lu
SF 5-8(b).01	3.25	5.69	5.79	2.79	1.26	5.79	6.45	4.52	2.22	6.89	4.99	8.42
SF 5-8(b).02	2.98	5.78	5.46	3.34	1.18	6.25	5.98	4.57	2.16	7.42	4.82	8.09
SF 5-8(b).03	3.15	5.63	5.59	2.85	1.26	5.56	6.42	4.48	2.28	7.20	5.14	8.28
SF 5-8(b).04	3.12	5.80	5.65	2.96	1.26	5.84	6.33	4.40	2.24	7.02	5.13	8.43
SF 5-8(b).05	3.25	5.66	5.65	2.73	1.24	5.61	6.28	4.57	2.21	6.81	5.05	8.15
SF 5-8(b).06	3.06	5.50	5.74	2.85	1.22	5.55	6.37	4.42	2.20	7.02	5.20	8.11
SF 5-8(b).07	3.11	5.78	5.58	2.85	1.29	5.68	6.38	4.27	2.15	6.96	5.14	8.43
SF 5-8(b).08	3.17	5.64	6.01	2.96	1.18	5.39	6.50	4.50	2.23	6.90	5.09	8.30
SF 5-8(b).09	3.10	5.47	5.71	2.99	1.24	5.57	6.60	4.44	2.27	7.11	5.05	8.15
SF 5-8(b).10	3.06	5.45	6.05	3.11	1.28	5.81	6.34	4.46	2.21	7.03	5.01	8.21
SF 5-8(b).11	3.25	5.69	5.77	2.81	1.28	5.72	6.29	4.41	2.25	7.02	5.05	8.22
SF 5-8(b).12	3.08	5.58	5.82	3.05	1.27	5.63	6.22	4.36	2.30	7.68	5.28	8.29
SF 5-8(b).13	2.95	5.53	5.94	2.98	1.31	5.75	6.47	4.44	2.22	6.92	5.09	8.17
SF 5-8(b).14	3.01	5.51	6.05	3.17	1.29	5.62	6.59	4.36	2.19	7.11	5.03	8.24
SF 5-8(b).15	3.03	5.87	5.86	3.43	1.24	6.11	6.05	4.50	2.20	7.59	4.92	8.40
SF 5-8(b).16	2.94	5.29	5.96	3.03	1.32	5.79	6.27	4.48	2.27	7.14	5.03	8.13
SF 5-8(b).17	2.99	5.77	5.80	3.10	1.26	5.68	6.48	4.40	2.19	7.26	5.07	8.39
SF 5-8(b).18	3.09	5.65	5.81	3.07	1.33	5.74	6.40	4.42	2.24	7.06	4.90	8.29
SF 5-8(b).19	3.02	5.65	5.73	2.97	1.26	5.62	6.27	4.32	2.21	6.87	4.83	8.20
SF 5-8(b).20	3.07	5.51	5.75	2.96	1.27	6.00	6.32	4.41	2.23	6.81	4.97	8.04
SF 5-8(b).21	3.20	5.70	5.55	2.81	1.29	5.87	6.44	4.42	2.22	6.92	5.00	8.16
SF 5-8(b).22	3.29	5.55	5.57	2.60	1.27	5.82	6.48	4.74	2.18	7.04	5.17	8.64
SF 5-8(b).23	3.18	5.73	5.66	2.90	1.26	5.63	6.55	4.42	2.28	7.22	4.96	8.28
SF 5-8(b).24	3.21	5.80	5.41	2.66	1.30	5.89	6.47	4.43	2.17	6.80	5.12	8.48
SF 5-8(b).25	3.14	5.66	5.62	2.79	1.27	5.71	6.41	4.42	2.19	7.14	5.20	8.31
SF 5-8(b).26	3.10	5.65	5.73	2.89	1.31	5.77	6.28	4.37	2.18	6.96	4.93	8.04
SF 5-8(b).27	3.15	5.81	5.65	2.86	1.28	5.57	6.47	4.56	2.23	7.04	5.14	8.39
Average	3.11	5.64	5.74	2.94	1.27	5.74	6.38	4.45	2.22	7.07	5.05	8.27
St. Deviation	0.10	0.13	0.17	0.19	0.04	0.18	0.15	0.09	0.04	0.22	0.11	0.15
2 Σ of Mean	0.04	0.05	0.06	0.07	0.01	0.07	0.06	0.04	0.01	0.08	0.04	0.06
% St. Deviation	3.09	2.38	2.91	6.30	2.77	3.15	2.28	2.08	1.75	3.09	2.21	1.76

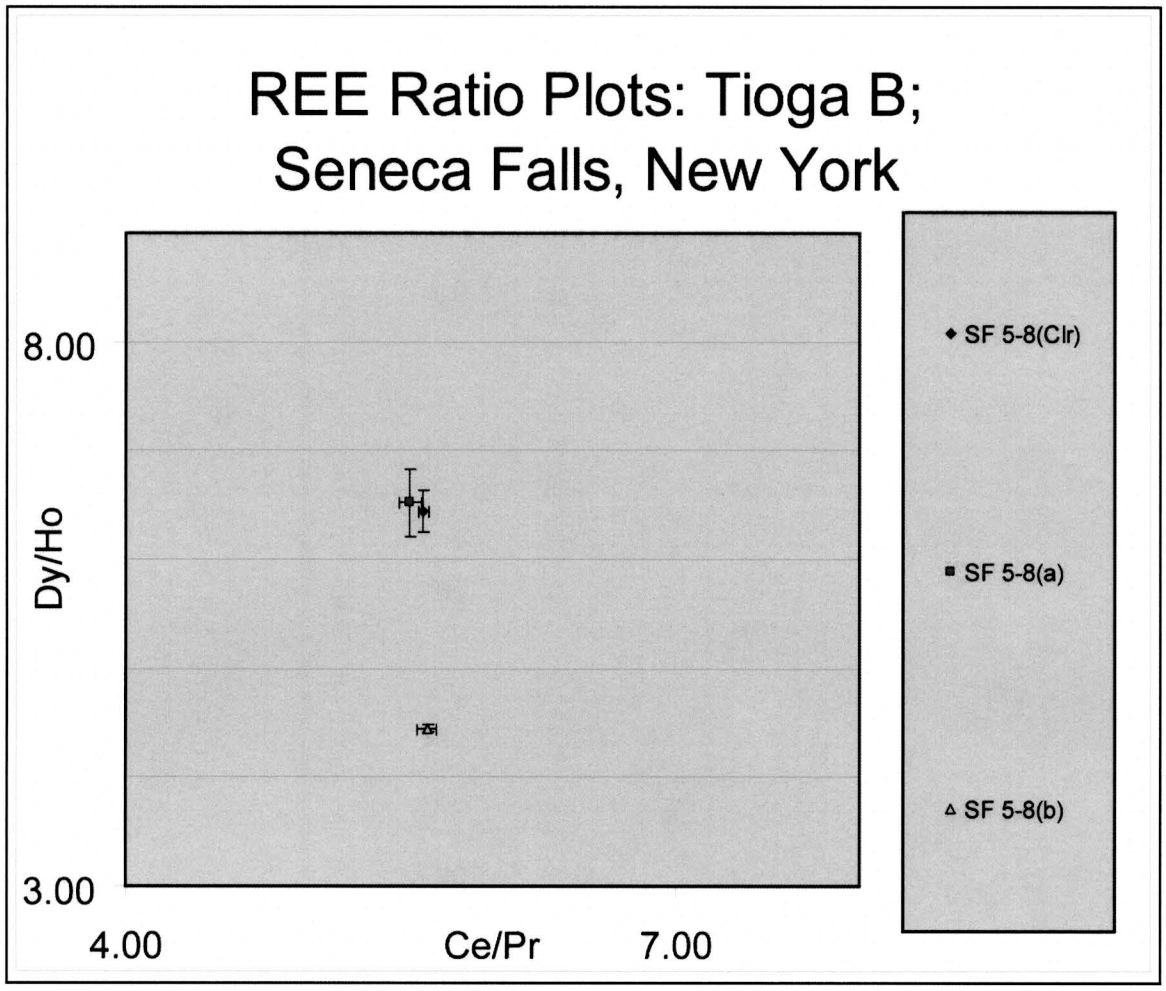
APPENDIX B.7.16:

Mean REE ratio plots for the layers SF 0-5(a) and SF 0-5(b) from the Seneca Stone Quarry. Plots are determined from concentration values listed in Appendices B.7.3, and B.7.6. Error bars are 2 sigma standard error of the mean. Scale and legend are given.



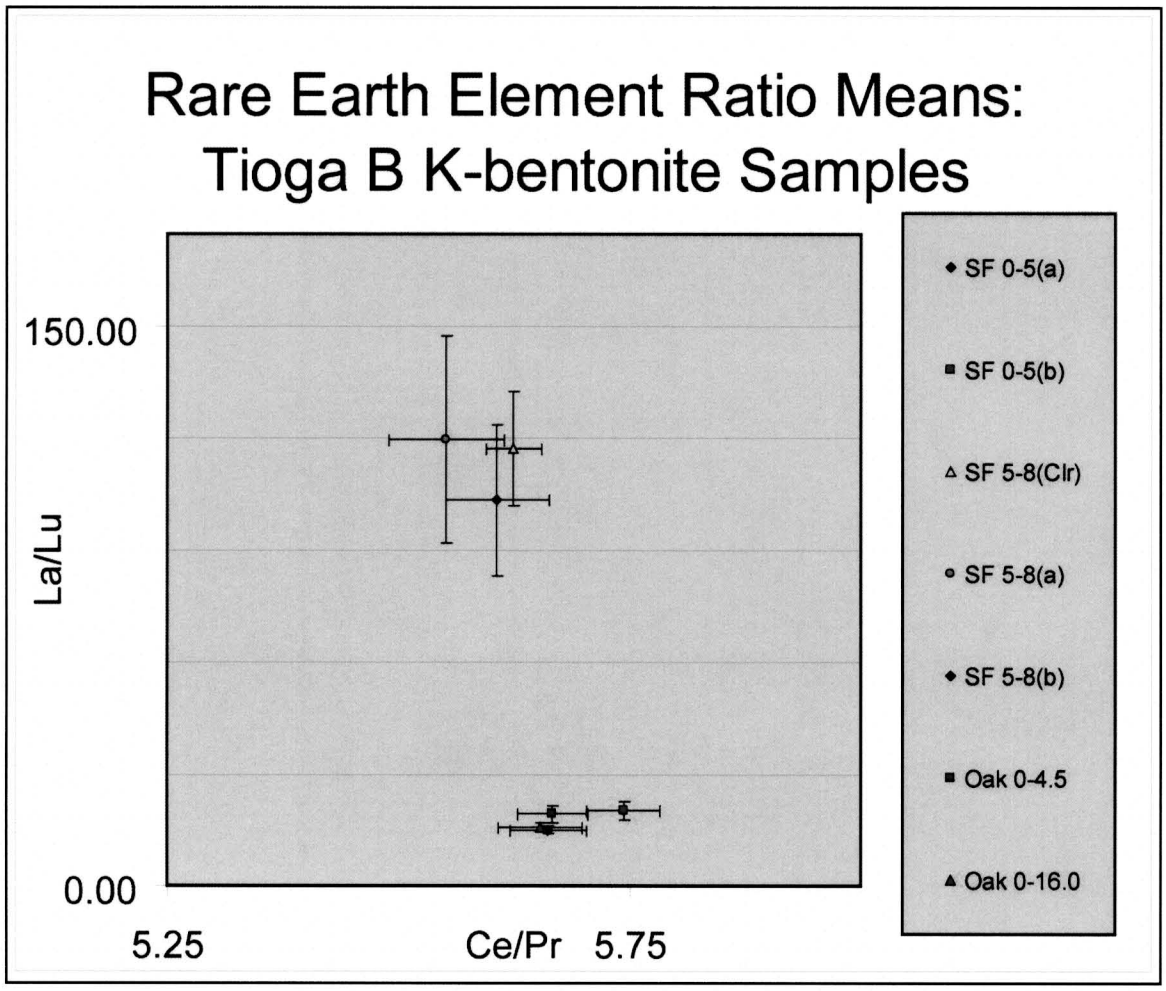
APPENDIX B.7.17:

Mean rare earth element ratios plots for layers SF 5-8(Clr), SF 5-8(a) and SF 5-8(b) from the Seneca Stone Quarry. Plots are determined from concentration values listed in Appendices B.7.9, and B.7.12, and B.7.15. Error bars are 2 sigma standard error of the mean. Scale and legend are given.



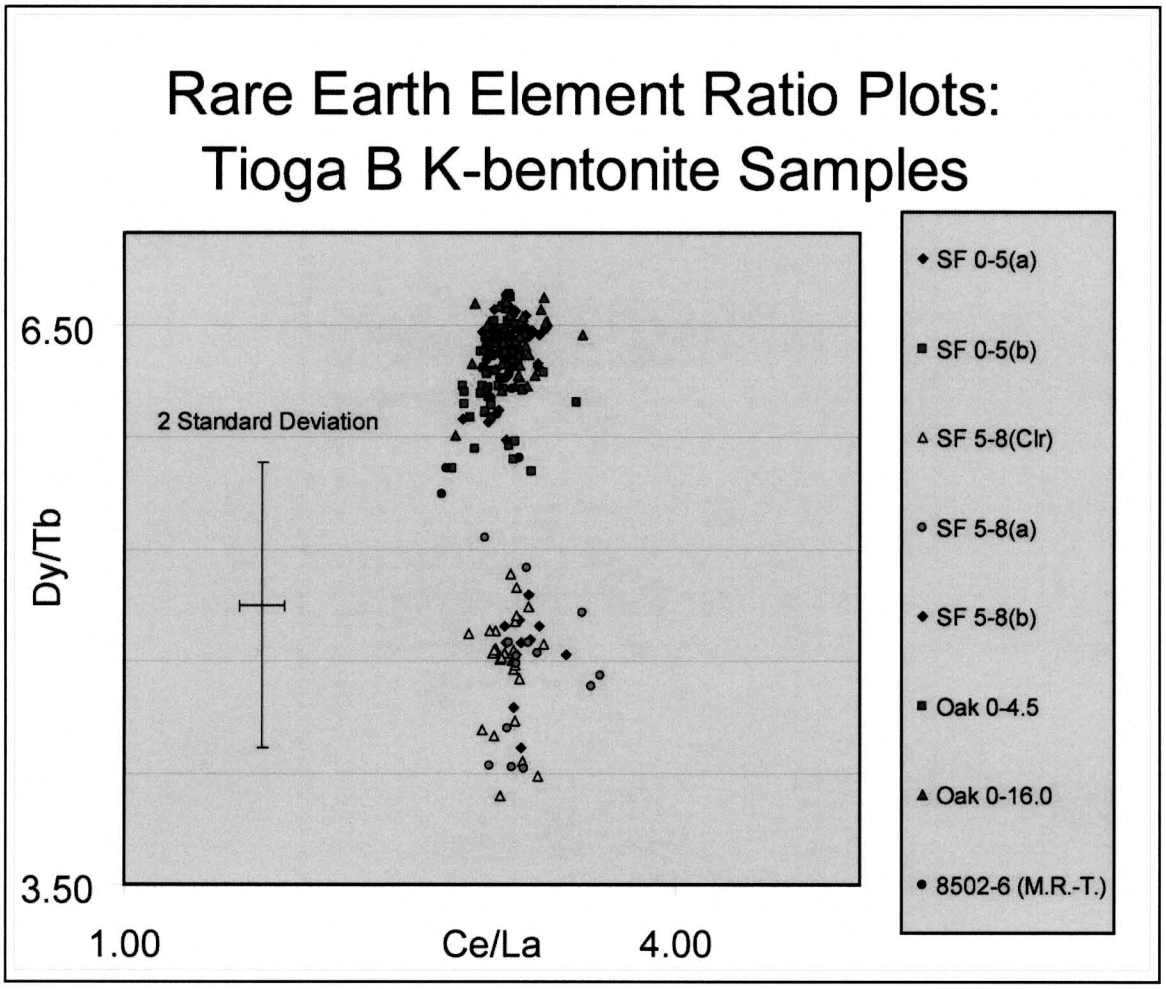
APPENDIX B.7.18:

Mean plots of Heavy REE versus Light REE for all layers sampled at Localities C and D in order to distinguish magma characteristics within layers from the same locality and same geographic area. Separate populations indicate the La/Lu enrichment in a given layer, therefore implicating varying magma geochemistry within a single layer. 2 Sigma error bars are shown.



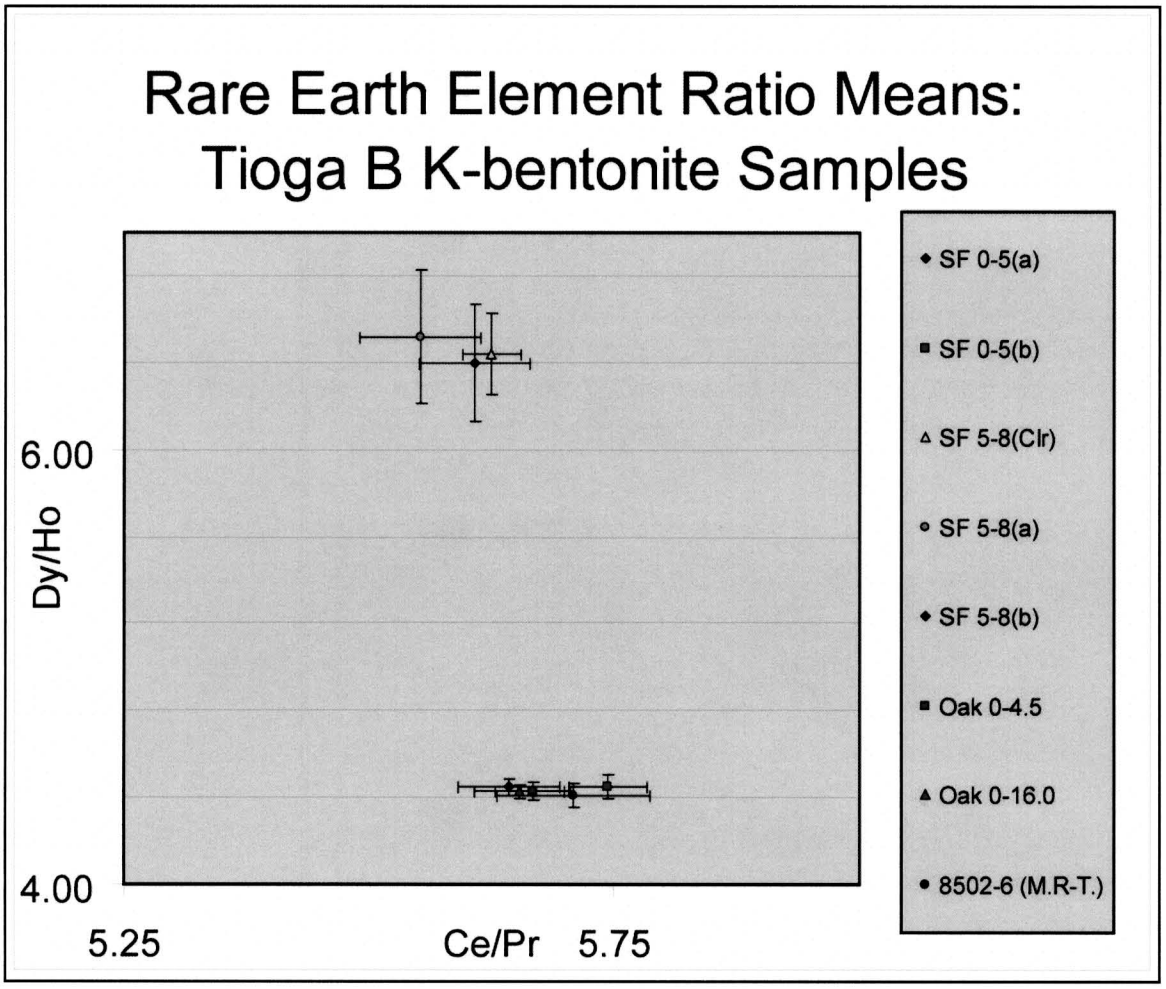
APPENDIX B.8.1:

Rare earth element ratios plots for all K-bentonite layers analyzed from Localities C and D. Analytes in this plot are Cerium, Lanthanum, Dysprosium, and Terbium. Scale and legend are given.



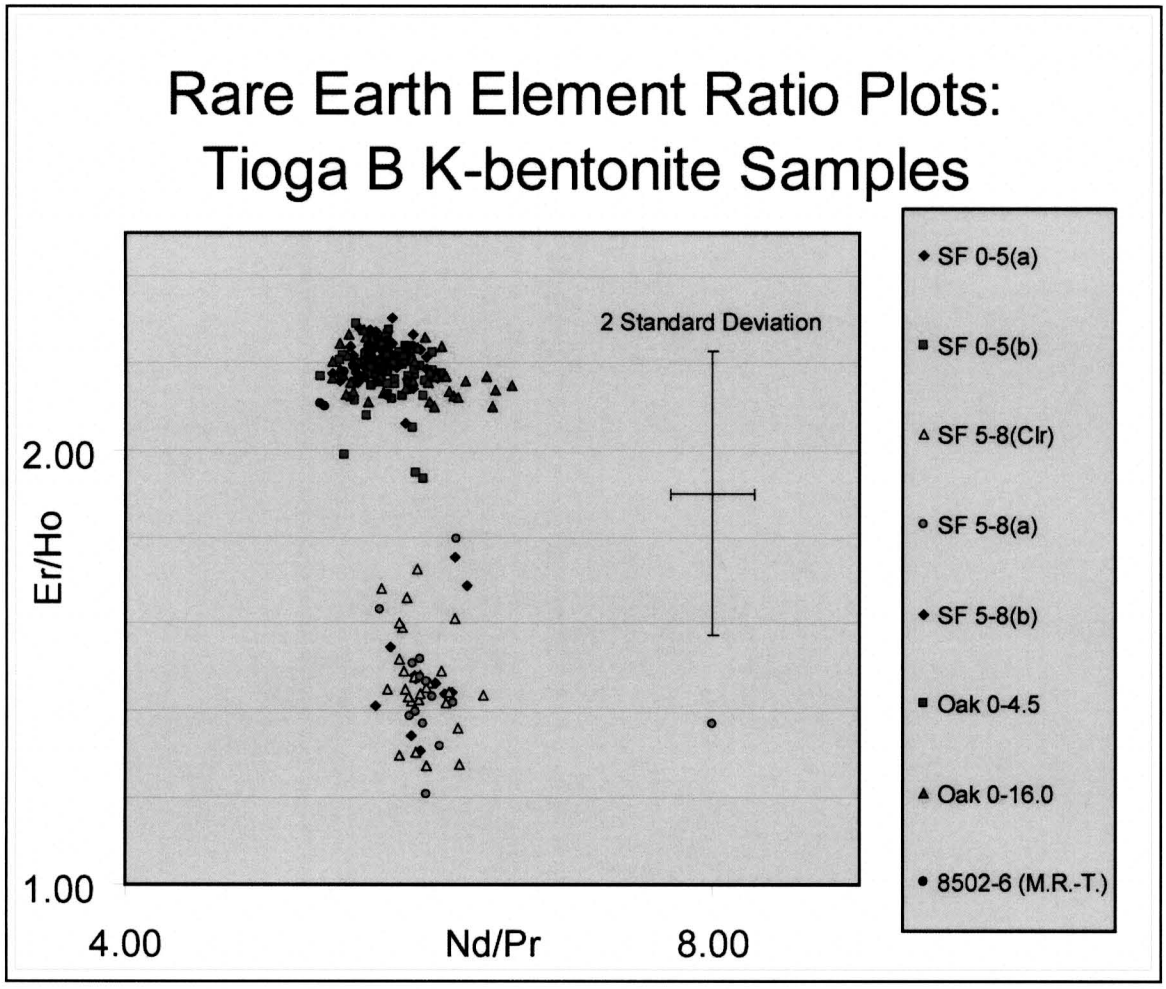
APPENDIX B.8.2:

Mean rare earth element ratios plots for all K-bentonite layers analyzed from Localities C and D. Analytes in this plot are Cerium, Praseodymium, Dysprosium, and Holmium. Error bars are 2 sigma standard error of the mean. Scale has been exaggerated for easier viewing. Scale and legend are given.



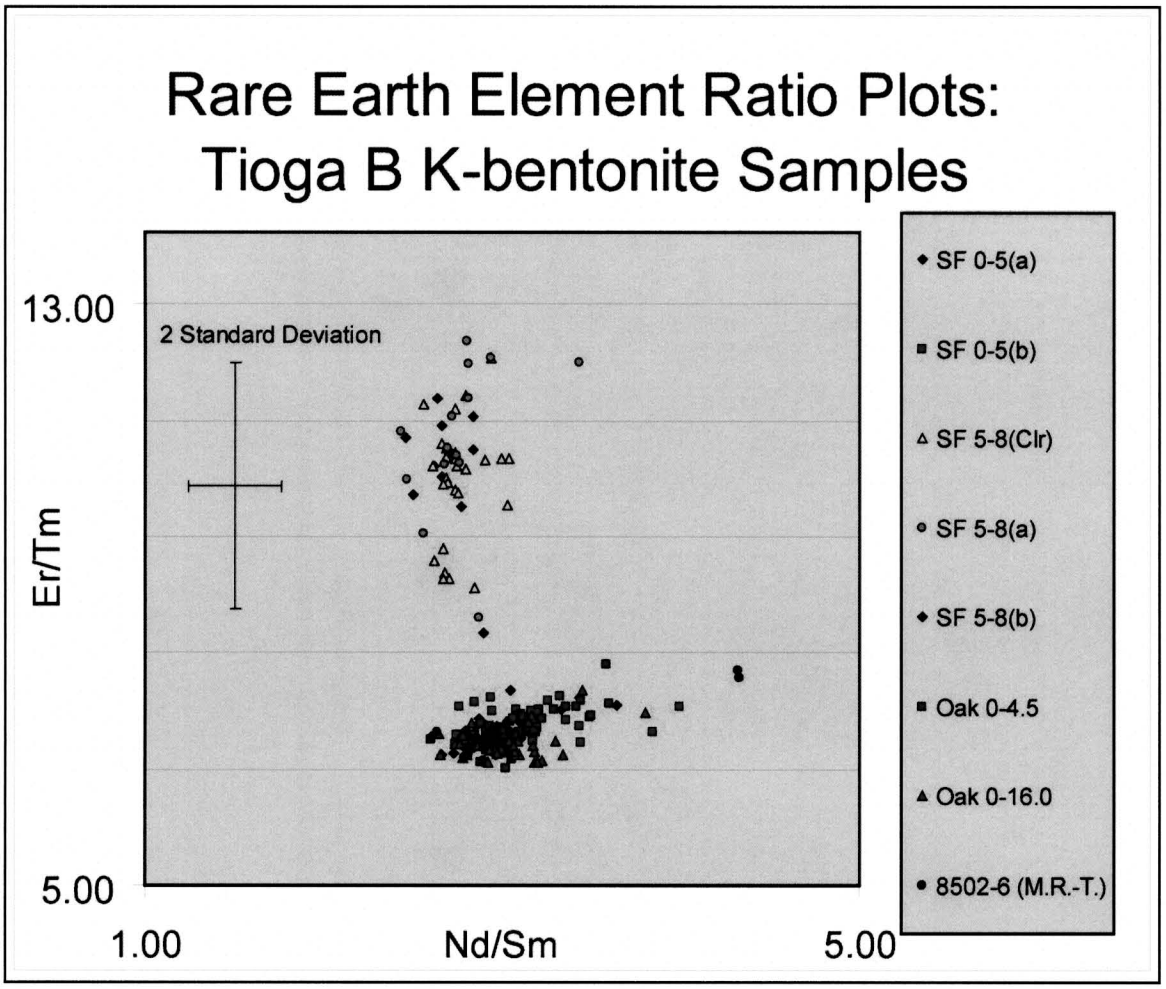
APPENDIX B.8.3:

Rare earth element ratios plots for all K-bentonite layers analyzed from Localities C and D. Analytes in this plot are Neodymium, Praseodymium, Erbium, and Holmium. Scale and legend are given.



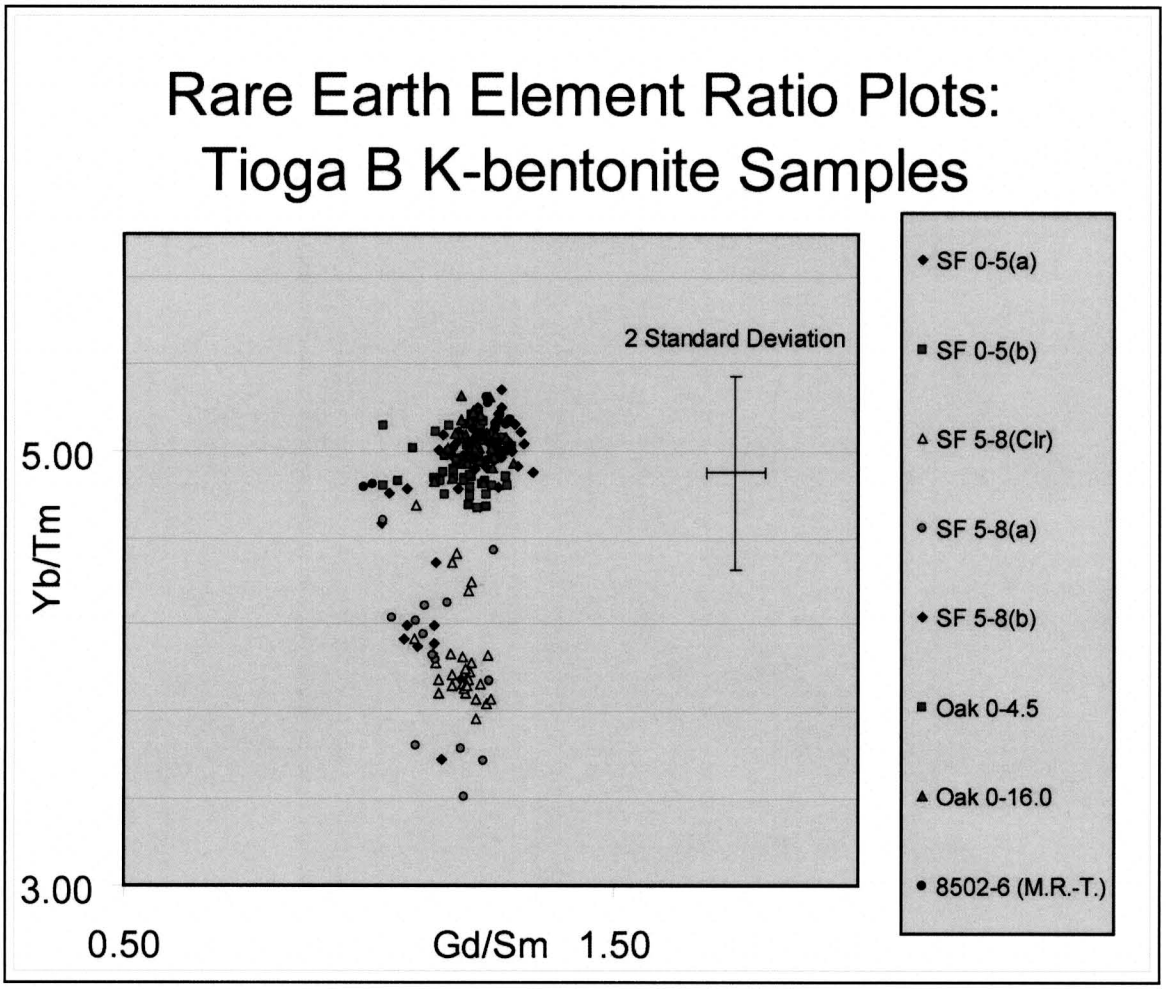
APPENDIX B.8.4:

Rare earth element ratios plots for all K-bentonite layers analyzed from Localities C and D. Analytes in this plot are Neodymium, Samarium, Erbium, and Thulium. Scale and legend are given.



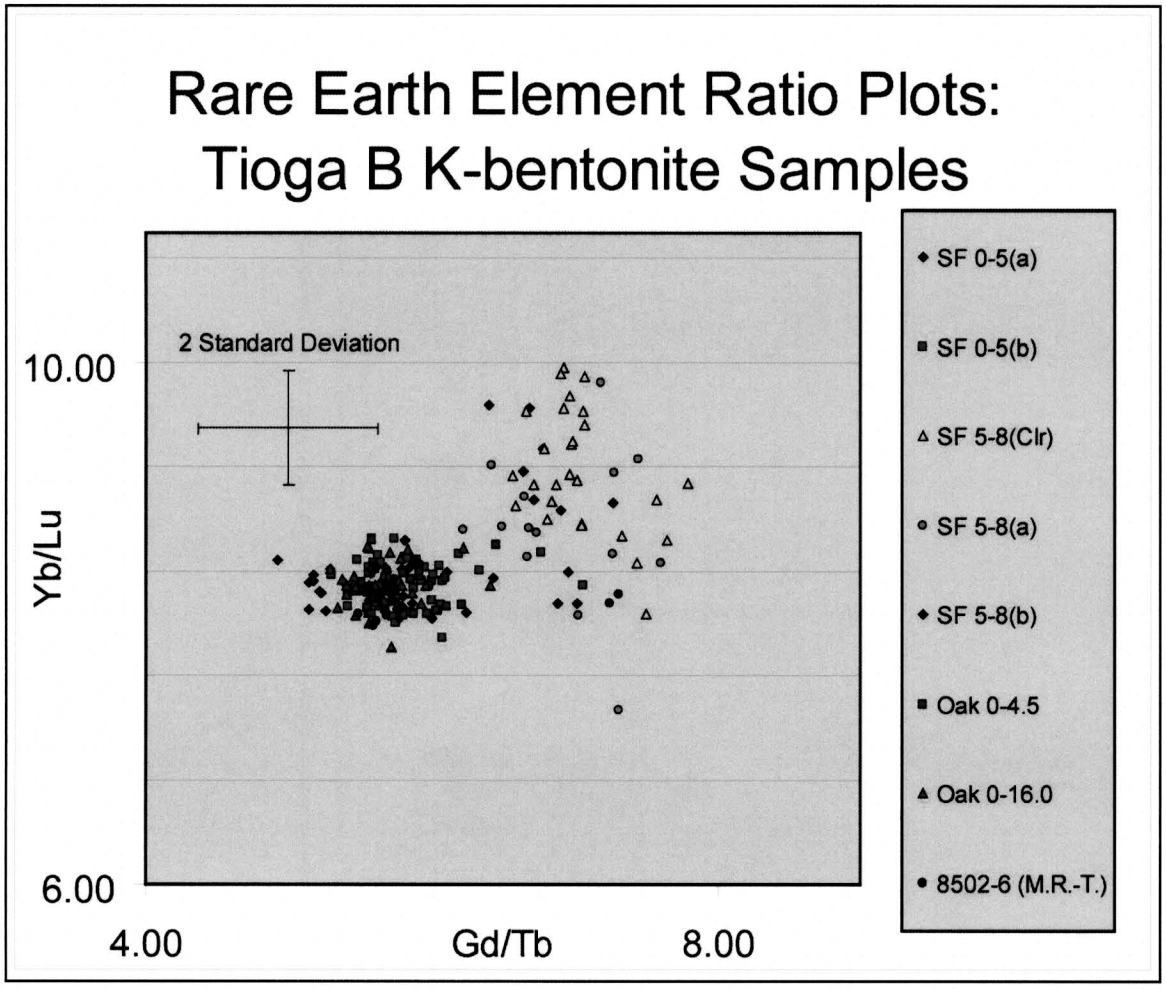
APPENDIX B.8.5:

Rare earth element ratios plots for all K-bentonite layers analyzed from Localities C and D. Analytes in this plot are Gadolinium, Samarium, Ytterbium, and Thulium. Scale and legend are given.



APPENDIX B.8.6:

Rare earth element ratios plots for all K-bentonite layers analyzed from Localities C and D. Analytes in this plot are Gadolinium, Terbium, Ytterbium, and Lutetium. Scale and legend are given.



APPENDIX B.9.1:

Trace element concentrations obtained from ICP-MS analysis of individual apatite phenocrysts within a K-bentonite layer 7 Fount 1(a) from Seven Fountains, Virginia. Since individual crystal weights could not be measured, values shown have no units. Average, standard deviation, 2 sigma standard error of the mean and percent standard deviation values are shown below each analyte used in further analyses.

Sample Name	P	Ca	Ca/P*	Sr	Y	La	Ce	Pr	Nd	Sm
7 Fount 1(a).01	3058.57	5697.08	0.88	1.36	39.87	4.69	15.32	2.97	18.71	6.52
7 Fount 1(a).02	1118.24	1813.67	0.77	-0.06	17.50	2.19	6.69	1.20	7.74	2.52
7 Fount 1(a).03	2279.17	4193.94	0.87	0.79	30.17	3.28	11.11	2.14	13.63	4.98
7 Fount 1(a).04	3036.52	5763.90	0.90	1.12	45.77	5.43	17.38	3.29	20.26	7.14
7 Fount 1(a).05	2561.13	4857.86	0.90	0.66	32.28	4.25	13.78	2.54	16.23	5.20
7 Fount 1(a).06	3791.44	7084.86	0.88	1.74	50.17	6.25	19.19	3.56	21.45	7.80
7 Fount 1(a).07	5461.25	10818.66	0.94	4.28	58.59	8.21	24.97	4.43	26.22	8.88
7 Fount 1(a).08	6540.23	12946.90	0.94	3.24	91.32	10.92	34.12	6.28	36.93	13.41
7 Fount 1(a).09	2505.37	4887.67	0.92	0.97	31.93	3.51	11.67	2.29	14.30	5.55
7 Fount 1(a).10	1983.74	3729.01	0.89	0.52	25.15	3.05	9.87	1.89	12.33	4.57
7 Fount 1(a).11	8742.50	16556.12	0.90	3.67	182.67	21.85	73.48	13.85	81.73	30.69
7 Fount 1(a).12	5542.86	9728.91	0.83	2.94	100.61	11.70	44.88	9.37	60.70	22.58
		Average		1.77	58.83	7.11	23.54	4.49	27.52	9.99
		St. Deviation		1.41	46.55	5.56	19.19	3.71	22.19	8.41
		2 Σ of Mean		0.81	26.88	3.21	11.08	2.14	12.81	4.85
		% St. Deviation		79.47	79.12	78.20	81.51	82.61	80.62	84.20

Sample Name	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Pb	Th	U
7 Fount 1(a).01	0.33	7.62	1.29	8.12	1.77	3.81	0.52	2.60	0.31	6.13	1.05	0.53
7 Fount 1(a).02	0.08	2.99	0.54	3.55	0.78	1.71	0.25	1.34	0.16	6.00	0.11	0.21
7 Fount 1(a).03	0.23	5.83	0.98	6.11	1.34	2.77	0.39	1.96	0.24	4.35	0.52	0.33
7 Fount 1(a).04	0.30	8.20	1.44	9.22	2.00	4.51	0.65	3.41	0.41	5.25	0.73	0.42
7 Fount 1(a).05	0.19	6.16	1.07	6.74	1.51	3.19	0.45	2.10	0.25	5.53	0.27	0.35
7 Fount 1(a).06	0.34	8.91	1.59	10.17	2.27	4.77	0.72	3.77	0.46	5.75	0.69	0.71
7 Fount 1(a).07	0.40	10.43	1.78	11.48	2.57	5.57	0.81	4.09	0.51	5.47	0.14	0.69
7 Fount 1(a).08	0.47	15.21	2.81	17.92	4.07	9.03	1.30	6.87	0.83	5.53	0.63	1.24
7 Fount 1(a).09	0.30	6.22	1.05	6.36	1.40	2.99	0.42	2.05	0.25	-39.31	0.72	0.41
7 Fount 1(a).10	0.23	5.12	0.86	5.15	1.12	2.38	0.33	1.65	0.19	6.04	0.39	0.24
7 Fount 1(a).11	0.78	38.57	6.48	40.76	9.25	20.18	2.95	14.98	1.86	0.28	0.79	1.03
7 Fount 1(a).12	0.54	28.22	4.27	24.91	5.13	10.78	1.58	8.57	1.08	3.91	-0.05	0.34
Average	0.35	11.96	2.01	12.54	2.77	5.97	0.87	4.45	0.55	1.24	0.50	0.54
St. Deviation	0.18	10.70	1.74	10.72	2.40	5.23	0.77	3.98	0.50	12.87	0.33	0.32
2 Σ of Mean	0.11	6.18	1.00	6.19	1.38	3.02	0.44	2.30	0.29	7.43	0.19	0.19
% St. Deviation	52.41	89.49	86.24	85.49	86.60	87.52	88.80	89.36	90.94	1034.65	65.94	59.32

APPENDIX B.9.2:

Percent relative standard deviation values for each element analyzed during ICP-MS analysis of individual apatite phenocrysts from the Seven Fountains, Virginia K-bentonite layer referred to as 7 Fount 1(a). These percent values are generated during 16 analytical passes, each with 5 replicate analyses, for each individual crystal analyzed.

Sample Name	P	Ca	Sr	Y	La	Ce	Pr	Nd	Sm	Eu
7 Fount 1(a).01	4.84	4.17	6.95	2.67	1.30	1.67	1.65	2.54	2.93	1.69
7 Fount 1(a).02	3.42	9.98	30.89	2.58	5.74	1.51	4.79	5.25	4.08	10.85
7 Fount 1(a).03	5.61	5.37	6.92	2.11	1.93	2.45	2.51	3.72	4.08	5.75
7 Fount 1(a).04	3.72	3.08	6.24	3.47	2.40	1.43	1.09	1.33	2.52	4.68
7 Fount 1(a).05	2.85	3.73	5.59	2.32	1.80	3.27	1.84	6.72	3.12	3.85
7 Fount 1(a).06	4.71	3.86	2.23	1.62	1.64	3.60	2.47	5.10	1.74	3.46
7 Fount 1(a).07	2.39	2.47	2.09	1.66	1.92	0.59	2.38	5.01	4.18	4.67
7 Fount 1(a).08	1.97	1.66	3.18	1.80	0.70	1.31	0.73	2.63	1.65	2.72
7 Fount 1(a).09	2.14	4.78	5.68	2.27	2.43	2.80	1.46	4.77	2.67	4.33
7 Fount 1(a).10	6.34	5.34	10.33	4.10	1.96	2.56	2.87	5.95	4.26	8.64
7 Fount 1(a).11	2.96	4.34	3.61	3.90	3.61	3.85	4.00	5.50	3.47	4.66
7 Fount 1(a).12	2.91	3.16	3.58	5.78	4.00	4.55	1.48	4.56	2.97	3.72

Sample Name	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Pb	Th	U
7 Fount 1(a).01	4.75	2.10	3.01	1.57	2.45	1.89	3.45	2.84	0.84	5.43	4.54
7 Fount 1(a).02	6.45	3.01	4.01	3.83	4.33	3.67	3.98	5.76	1.32	10.88	7.60
7 Fount 1(a).03	3.08	3.55	3.36	0.66	5.16	1.41	1.18	4.35	3.41	8.68	7.84
7 Fount 1(a).04	3.06	0.76	3.57	2.58	2.19	2.79	3.34	2.12	1.17	5.90	3.79
7 Fount 1(a).05	4.26	3.68	2.42	3.47	5.50	4.61	3.57	3.95	1.69	3.80	6.84
7 Fount 1(a).06	3.48	2.17	4.96	3.88	6.29	5.66	4.13	4.88	1.69	4.80	16.93
7 Fount 1(a).07	2.60	4.08	2.53	4.22	3.97	3.34	2.24	3.90	1.62	15.40	4.45
7 Fount 1(a).08	2.88	1.00	1.72	1.88	2.92	2.83	2.14	1.34	2.30	4.71	3.57
7 Fount 1(a).09	3.78	1.57	4.57	2.68	3.21	2.19	2.65	2.81	3.07	5.03	12.90
7 Fount 1(a).10	1.80	2.27	3.62	3.09	5.13	2.88	3.43	0.93	1.75	4.59	5.08
7 Fount 1(a).11	4.20	3.20	3.29	2.45	4.24	2.90	2.00	1.18	15.12	6.34	5.12
7 Fount 1(a).12	3.90	3.07	4.17	3.14	4.85	4.71	4.64	2.35	3.92	97.24	7.26

APPENDIX B.9.3:

Rare earth element ratios derived from trace element concentration values found in Appendix B.9.1 for individual apatite phenocrysts from the Seven Fountains, Virginia K-bentonite layer referred to as 7 Fount 1(a). Mean, standard deviation, 2 Sigma standard error of the mean, and percent standard deviation values for trace elements are below each ratio.

Sample Name	Ce/La	Ce/Pr	Nd/Pr	Nd/Sm	Gd/Sm	Gd/Tb	Dy/Tb	Dy/Ho	Er/Ho	Er/Tm	Yb/Tm	Yb/Lu
7 Fount 1(a).01	3.27	5.15	6.29	2.87	1.17	5.90	6.29	4.57	2.15	7.29	4.98	8.31
7 Fount 1(a).02	3.06	5.59	6.47	3.07	1.19	5.49	6.51	4.52	2.18	6.72	5.27	8.45
7 Fount 1(a).03	3.38	5.19	6.36	2.74	1.17	5.96	6.24	4.55	2.06	7.03	4.98	8.31
7 Fount 1(a).04	3.20	5.29	6.16	2.84	1.15	5.69	6.40	4.60	2.25	6.91	5.23	8.25
7 Fount 1(a).05	3.24	5.42	6.39	3.12	1.18	5.78	6.32	4.47	2.12	7.10	4.67	8.54
7 Fount 1(a).06	3.07	5.39	6.02	2.75	1.14	5.61	6.40	4.48	2.10	6.62	5.22	8.16
7 Fount 1(a).07	3.04	5.64	5.92	2.95	1.17	5.84	6.43	4.46	2.16	6.87	5.04	8.00
7 Fount 1(a).08	3.12	5.43	5.88	2.75	1.13	5.41	6.37	4.40	2.22	6.92	5.27	8.31
7 Fount 1(a).09	3.33	5.09	6.23	2.58	1.12	5.94	6.08	4.54	2.13	7.19	4.93	8.23
7 Fount 1(a).10	3.24	5.22	6.51	2.69	1.12	5.98	6.02	4.59	2.12	7.14	4.94	8.46
7 Fount 1(a).11	3.36	5.30	5.90	2.66	1.26	5.96	6.29	4.41	2.18	6.83	5.07	8.07
7 Fount 1(a).12	3.84	4.79	6.48	2.69	1.25	6.60	5.83	4.86	2.10	6.84	5.44	7.96
AVERAGE	3.26	5.29	6.22	2.81	1.17	5.85	6.27	4.54	2.15	6.96	5.09	8.26
St. Deviation	0.22	0.23	0.24	0.17	0.04	0.31	0.20	0.12	0.05	0.20	0.21	0.18
2 Σ of Mean	0.12	0.13	0.14	0.10	0.03	0.18	0.11	0.07	0.03	0.11	0.12	0.11
% St. Deviation	6.61	4.36	3.81	5.91	3.81	5.23	3.14	2.67	2.48	2.85	4.11	2.22

APPENDIX B.9.4:

Trace element concentrations obtained from ICP-MS analysis of individual apatite phenocrysts within a K-bentonite layer 7 Fount 1(b) from Seven Fountains, Virginia. Since individual crystal weights could not be measured, values shown have no units. Average, standard deviation, 2 sigma standard error of the mean and percent standard deviation values are shown below each analyte used in further analyses.

Sample Name	P	Ca	Ca/P*	Sr	Y	La	Ce	Pr	Nd	Sm
7 Fount 1(b).01	16427.02	33529.75	0.97	8.92	226.66	28.50	88.56	15.95	95.43	33.77
7 Fount 1(b).02	2715.33	5394.63	0.94	1.27	39.80	4.76	14.97	2.66	16.12	5.67
7 Fount 1(b).03	2996.38	5873.37	0.93	1.04	42.08	5.22	16.37	3.03	18.44	6.81
7 Fount 1(b).04	9266.09	18918.77	0.97	5.03	132.49	16.23	50.62	9.08	53.76	19.17
7 Fount 1(b).05	2311.14	4250.59	0.87	0.93	35.46	3.96	12.95	2.37	14.52	5.20
7 Fount 1(b).06	6441.15	13309.45	0.98	3.03	95.21	11.96	35.89	6.58	39.93	14.06
7 Fount 1(b).07	5441.68	10727.84	0.93	3.29	89.73	10.10	32.59	5.92	36.85	13.29
7 Fount 1(b).08	1150.22	1889.44	0.78	-0.15	16.33	1.99	6.41	1.17	6.90	2.55
7 Fount 1(b).09	5138.80	10072.57	0.93	2.22	70.52	8.31	27.56	5.26	32.08	11.91
7 Fount 1(b).10	2580.26	4989.50	0.91	0.65	37.68	4.80	14.76	2.70	16.17	5.80
7 Fount 1(b).11	7259.43	14943.52	0.97	2.56	141.06	16.32	51.81	10.45	70.15	23.85
7 Fount 1(b).12	8621.91	17252.06	0.95	3.45	173.96	19.76	64.90	13.03	84.43	29.61
7 Fount 1(b).13	2839.65	5673.69	0.94	2.97	51.08	2.48	11.37	3.06	21.73	9.47
7 Fount 1(b).14	5923.49	11313.30	0.90	1.58	106.85	11.64	37.86	8.52	56.33	20.48
7 Fount 1(b).15	9556.27	18840.11	0.93	3.71	186.94	22.47	75.31	14.44	84.17	31.51
7 Fount 1(b).16	8678.37	18013.78	0.98	4.07	168.99	18.49	60.37	11.90	75.71	26.70
7 Fount 1(b).17	7880.73	16255.93	0.98	3.04	196.80	18.08	63.45	13.39	88.14	32.37
7 Fount 1(b).18	5880.64	10950.62	0.88	2.52	118.69	9.79	36.88	7.69	48.49	19.86
7 Fount 1(b).19	21171.94	44121.38	0.99	10.77	430.42	54.40	170.22	32.43	197.83	69.07
		Average		3.20	124.25	14.17	45.94	8.93	55.64	20.06
		St. Deviation		2.69	97.12	12.23	38.35	7.30	44.75	15.63
		2 Σ of Mean		1.23	44.56	5.61	17.60	3.35	20.53	7.17
		% St. Deviation		83.94	78.16	86.34	83.48	81.80	80.42	77.91

APPENDIX B.9.4 continued

Sample Name	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Pb	Th	U
7 Fount 1(b).01	0.93	38.84	7.21	46.14	10.26	22.59	3.29	17.02	2.06	5.34	0.87	2.69
7 Fount 1(b).02	0.18	6.62	1.22	7.80	1.77	3.89	0.57	2.93	0.35	3.35	0.38	0.53
7 Fount 1(b).03	0.29	7.63	1.36	8.65	1.89	4.25	0.61	3.16	0.38	6.10	0.73	0.36
7 Fount 1(b).04	0.55	22.50	4.03	26.01	5.91	12.91	1.92	9.92	1.19	5.59	0.44	1.56
7 Fount 1(b).05	0.19	6.10	1.10	6.84	1.54	3.37	0.48	2.46	0.30	6.36	0.23	0.41
7 Fount 1(b).06	0.34	16.18	2.92	18.46	4.16	9.31	1.38	7.16	0.88	6.30	0.21	0.98
7 Fount 1(b).07	0.43	15.51	2.70	17.58	3.98	8.74	1.25	6.50	0.81	6.73	0.22	1.05
7 Fount 1(b).08	0.10	3.03	0.52	3.39	0.74	1.67	0.23	1.24	0.15	6.93	0.14	0.23
7 Fount 1(b).09	0.40	13.35	2.29	13.99	3.00	6.40	0.91	4.36	0.53	6.65	0.62	0.52
7 Fount 1(b).10	0.19	6.60	1.16	7.50	1.63	3.64	0.52	2.72	0.34	7.02	0.30	0.51
7 Fount 1(b).11	0.45	28.02	4.92	31.49	7.05	15.57	2.23	11.56	1.41	0.80	-0.12	0.86
7 Fount 1(b).12	0.72	35.10	6.00	38.39	8.54	18.85	2.69	13.99	1.70	1.82	0.45	2.09
7 Fount 1(b).13	0.29	10.92	1.82	11.07	2.36	5.19	0.76	4.00	0.50	1.12	0.23	0.27
7 Fount 1(b).14	0.79	23.87	4.14	25.15	5.70	12.22	1.77	9.18	1.10	0.60	2.32	0.49
7 Fount 1(b).15	0.70	37.74	6.65	41.21	9.57	21.43	3.02	15.82	1.92	0.95	0.24	1.04
7 Fount 1(b).16	0.65	32.58	5.73	35.81	8.18	17.64	2.52	13.02	1.56	1.09	0.17	0.98
7 Fount 1(b).17	0.93	39.60	6.85	42.69	9.61	21.79	3.00	15.49	1.93	0.64	0.81	1.28
7 Fount 1(b).18	0.59	24.29	4.12	24.97	5.75	12.92	1.76	8.92	1.12	0.78	0.43	0.56
7 Fount 1(b).19	1.85	81.61	14.31	89.40	20.17	45.14	6.51	33.74	4.03	1.06	1.41	2.45
Average	0.56	23.69	4.16	26.13	5.89	13.03	1.86	9.64	1.17	3.64	0.53	0.99
St. Deviation	0.40	18.61	3.27	20.50	4.64	10.39	1.49	7.73	0.93	2.72	0.55	0.73
2 Σ of Mean	0.18	8.54	1.50	9.41	2.13	4.76	0.68	3.55	0.43	1.25	0.25	0.34
% St. Deviation	72.23	78.57	78.68	78.44	78.89	79.72	79.80	80.16	79.10	74.54	103.91	73.76

APPENDIX B.9.5:

Percent relative standard deviation values for each element analyzed during ICP-MS analysis of individual apatite phenocrysts from the Seven Fountains, Virginia K-bentonite layer referred to as 7 Fount 1(b). These percent values are generated during the 16 analytical passes, each with 5 replicate analyses, for each individual crystal analyzed.

Sample Name	P	Ca	Sr	Y	La	Ce	Pr	Nd	Sm	Eu
7 Fount 1(b).01	2.57	2.60	3.06	3.07	1.66	0.57	1.27	2.71	1.67	2.01
7 Fount 1(b).02	3.88	3.49	2.86	1.97	3.01	3.58	2.24	4.10	4.21	4.87
7 Fount 1(b).03	5.43	3.30	2.26	4.35	2.98	1.07	2.29	6.30	2.92	2.82
7 Fount 1(b).04	1.70	1.39	2.17	2.72	2.99	3.21	1.96	2.35	3.75	3.64
7 Fount 1(b).05	3.00	3.58	0.42	2.97	3.42	2.48	0.95	4.37	1.53	6.11
7 Fount 1(b).06	2.55	2.82	3.54	3.21	2.30	3.22	2.55	3.54	2.80	5.93
7 Fount 1(b).07	2.73	3.10	2.41	3.11	1.08	1.61	2.23	6.76	1.54	3.89
7 Fount 1(b).08	7.04	7.37	18.47	2.63	4.18	2.61	3.97	4.82	8.11	5.70
7 Fount 1(b).09	2.48	4.64	3.42	3.04	2.46	3.56	2.73	1.07	2.48	3.03
7 Fount 1(b).10	7.91	9.77	4.30	2.92	2.97	0.91	1.56	6.78	2.51	2.40
7 Fount 1(b).11	5.74	6.75	4.65	2.94	3.21	2.74	2.21	4.73	2.81	3.47
7 Fount 1(b).12	3.61	6.15	4.18	1.80	5.47	3.06	2.10	6.89	2.57	7.48
7 Fount 1(b).13	3.44	5.15	1.98	4.62	17.55	4.74	3.42	5.00	3.17	9.28
7 Fount 1(b).14	5.47	1.88	7.64	4.22	3.34	4.19	2.23	3.56	3.14	3.26
7 Fount 1(b).15	2.90	4.56	3.40	3.58	2.10	3.24	3.07	2.52	3.46	5.18
7 Fount 1(b).16	3.42	7.35	3.58	1.98	5.38	2.37	4.12	8.38	3.22	7.61
7 Fount 1(b).17	2.46	3.94	4.75	3.70	3.95	1.62	3.30	6.68	3.07	3.59
7 Fount 1(b).18	3.78	4.59	2.51	5.48	5.28	3.00	3.25	2.58	3.78	5.27
7 Fount 1(b).19	4.23	3.91	3.54	5.74	3.86	6.23	1.98	8.67	4.60	1.15

Sample Name	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Pb	Th	U
7 Fount 1(b).01	1.46	2.37	1.55	2.90	4.28	2.37	3.54	2.39	0.93	3.82	2.78
7 Fount 1(b).02	4.91	2.03	2.21	3.24	3.28	3.54	2.34	3.79	3.25	2.41	4.62
7 Fount 1(b).03	2.05	1.09	2.32	0.69	1.63	3.04	3.42	1.86	0.88	5.07	2.89
7 Fount 1(b).04	3.28	2.02	2.58	2.38	1.65	3.54	2.40	1.40	2.34	5.24	1.75
7 Fount 1(b).05	3.14	3.32	4.18	3.57	5.50	4.12	3.95	3.46	0.94	8.43	3.48
7 Fount 1(b).06	2.06	2.70	4.18	2.93	2.24	2.80	1.87	2.57	0.96	3.07	2.05
7 Fount 1(b).07	2.35	1.94	1.64	1.52	2.13	1.74	2.20	2.29	0.92	10.97	3.21
7 Fount 1(b).08	3.77	1.39	4.25	2.75	3.79	4.12	2.07	3.57	0.82	54.31	4.91
7 Fount 1(b).09	2.64	1.97	2.23	2.46	4.51	1.69	3.96	1.79	1.24	2.90	4.79
7 Fount 1(b).10	2.57	2.37	5.15	6.33	5.83	2.98	2.20	5.29	0.69	15.36	3.25
7 Fount 1(b).11	2.40	3.01	1.73	3.38	3.51	2.79	2.52	2.60	3.08	27.08	2.55
7 Fount 1(b).12	4.22	3.65	3.99	3.70	2.70	1.67	3.12	2.76	3.25	9.93	188.82
7 Fount 1(b).13	6.58	2.75	4.16	4.99	1.76	3.13	1.12	3.84	4.04	18.25	6.91
7 Fount 1(b).14	2.69	2.15	1.75	2.22	2.97	4.02	2.85	1.78	5.21	5.01	7.58
7 Fount 1(b).15	4.42	2.23	3.01	2.19	4.08	3.19	4.50	2.64	5.49	32.37	2.95
7 Fount 1(b).16	2.15	4.27	6.49	4.98	4.85	2.38	4.73	3.38	5.89	10.03	1.81
7 Fount 1(b).17	3.94	4.08	4.69	4.06	3.37	3.54	3.50	3.47	5.59	9.20	4.81
7 Fount 1(b).18	4.32	3.35	3.18	2.74	2.18	2.49	1.55	1.04	12.96	21.58	4.05
7 Fount 1(b).19	2.00	2.09	3.49	1.35	3.20	1.98	2.64	1.72	7.16	7.88	3.12

APPENDIX B.9.6:

Rare earth element ratios derived from trace element concentration values found in Appendix B.9.4 for individual apatite phenocrysts from the Seven Fountains, Virginia K-bentonite layer referred to as 7 Fount 1(b). Mean, standard deviation, 2 Sigma standard error of the mean, and percent standard deviation values for trace elements are below each ratio.

Sample Name	Ce/La	Ce/Pr	Nd/Pr	Nd/Sm	Gd/Sm	Gd/Tb	Dy/Tb	Dy/Ho	Er/Ho	Er/Tm	Yb/Tm	Yb/Lu
7 Fount 1(b).01	3.11	5.55	5.98	2.83	1.15	5.39	6.40	4.50	2.20	6.86	5.17	8.25
7 Fount 1(b).02	3.14	5.62	6.06	2.84	1.17	5.44	6.41	4.41	2.20	6.85	5.16	8.30
7 Fount 1(b).03	3.14	5.40	6.08	2.71	1.12	5.60	6.35	4.58	2.25	6.94	5.17	8.33
7 Fount 1(b).04	3.12	5.58	5.92	2.80	1.17	5.58	6.46	4.40	2.19	6.73	5.17	8.31
7 Fount 1(b).05	3.27	5.46	6.13	2.79	1.17	5.57	6.24	4.43	2.18	6.97	5.10	8.23
7 Fount 1(b).06	3.00	5.46	6.07	2.84	1.15	5.55	6.33	4.44	2.24	6.76	5.20	8.11
7 Fount 1(b).07	3.23	5.50	6.22	2.77	1.17	5.74	6.51	4.42	2.20	6.98	5.19	8.03
7 Fount 1(b).08	3.23	5.48	5.90	2.71	1.19	5.79	6.49	4.59	2.27	7.15	5.30	8.33
7 Fount 1(b).09	3.32	5.24	6.10	2.69	1.12	5.83	6.11	4.67	2.14	7.04	4.79	8.26
7 Fount 1(b).10	3.08	5.47	5.99	2.79	1.14	5.67	6.44	4.59	2.23	6.97	5.22	8.02
7 Fount 1(b).11	3.18	4.96	6.71	2.94	1.17	5.70	6.40	4.47	2.21	6.99	5.19	8.17
7 Fount 1(b).12	3.28	4.98	6.48	2.85	1.19	5.85	6.39	4.49	2.21	7.00	5.20	8.24
7 Fount 1(b).13	4.59	3.71	7.09	2.29	1.15	6.00	6.07	4.68	2.20	6.81	5.25	8.03
7 Fount 1(b).14	3.25	4.45	6.61	2.75	1.17	5.77	6.08	4.41	2.14	6.91	5.19	8.32
7 Fount 1(b).15	3.35	5.22	5.83	2.67	1.20	5.68	6.20	4.30	2.24	7.10	5.24	8.23
7 Fount 1(b).16	3.27	5.07	6.36	2.84	1.22	5.69	6.25	4.38	2.16	7.01	5.17	8.33
7 Fount 1(b).17	3.51	4.74	6.58	2.72	1.22	5.78	6.23	4.44	2.27	7.27	5.17	8.03
7 Fount 1(b).18	3.77	4.80	6.31	2.44	1.22	5.90	6.06	4.34	2.25	7.35	5.07	7.97
7 Fount 1(b).19	3.13	5.25	6.10	2.86	1.18	5.70	6.25	4.43	2.24	6.94	5.19	8.37
AVERAGE	3.31	5.15	6.24	2.74	1.17	5.70	6.30	4.47	2.21	6.98	5.17	8.20
St. Deviation	0.35	0.48	0.33	0.15	0.03	0.15	0.15	0.10	0.04	0.16	0.10	0.13
2 Σ of Mean	0.16	0.22	0.15	0.07	0.01	0.07	0.07	0.05	0.02	0.07	0.05	0.06
% St. Deviation	10.68	9.27	5.25	5.52	2.59	2.67	2.32	2.34	1.76	2.26	2.00	1.58

APPENDIX B.9.7:

Trace element concentrations obtained from ICP-MS analysis of individual apatite phenocrysts within a K-bentonite layer 7 Fount 1(c) from Seven Fountains, Virginia. Since individual crystal weights could not be measured, values shown have no units. Average, standard deviation, 2 sigma standard error of the mean and percent standard deviation values are shown below each analyte used in further analyses.

Sample Name	P	Ca	Ca/P*	Sr	Y	La	Ce	Pr	Nd	Sm
7 Fount 1(c).01	23416.17	48920.83	0.99	13.42	313.31	41.55	121.24	22.48	136.15	47.49
7 Fount 1(c).02	13872.75	27801.77	0.95	7.29	192.27	24.02	74.82	13.54	79.13	28.04
7 Fount 1(c).03	20338.68	40329.02	0.94	12.88	235.80	33.73	109.70	20.37	120.47	43.90
7 Fount 1(c).04	29777.69	63080.93	1.00	17.53	409.60	47.76	152.66	28.55	172.36	63.45
7 Fount 1(c).05	12892.57	25933.13	0.95	7.15	173.98	21.60	68.56	12.45	74.35	26.70
7 Fount 1(c).06	14705.57	29975.53	0.96	8.48	201.35	24.51	77.15	14.42	86.51	30.35
7 Fount 1(c).07	13334.43	27325.35	0.97	7.73	173.57	23.31	72.42	13.86	86.03	30.09
7 Fount 1(c).08	13683.37	27757.44	0.96	7.38	198.78	23.12	72.52	13.48	80.45	28.74
7 Fount 1(c).09	9321.24	18503.35	0.94	4.70	140.94	17.86	56.96	10.43	62.08	21.98
7 Fount 1(c).10	11074.97	22344.73	0.95	6.93	129.96	16.70	55.23	10.52	63.52	23.59
7 Fount 1(c).11	16871.44	35429.00	0.99	8.25	293.53	39.58	129.21	25.24	160.42	57.46
7 Fount 1(c).12	13386.90	27683.82	0.98	6.65	251.30	32.63	106.46	20.64	126.13	45.48
7 Fount 1(c).13	23694.28	53733.77	1.07	14.94	511.09	62.87	203.38	38.91	229.83	82.75
7 Fount 1(c).14	8942.26	18423.03	0.97	4.18	191.91	21.15	75.26	14.45	87.72	32.25
7 Fount 1(c).15	13221.08	28380.06	1.01	7.61	269.67	34.57	122.62	23.70	143.97	51.80
7 Fount 1(c).16	8807.37	17108.95	0.92	4.06	162.99	17.84	63.45	12.13	75.26	28.52
7 Fount 1(c).17	7313.04	15022.82	0.97	3.54	154.70	15.91	54.23	10.86	68.01	25.16
7 Fount 1(c).18	8975.75	17367.09	0.91	3.62	178.69	19.86	68.29	13.30	81.56	29.93
7 Fount 1(c).19	11881.64	24682.24	0.98	6.16	249.97	30.04	102.11	20.00	125.27	45.82
7 Fount 1(c).20	16204.23	33166.84	0.97	8.76	325.55	38.79	130.65	24.52	148.77	53.46
		Average		8.06	237.95	29.37	95.85	18.19	110.40	39.85
		St. Deviation		3.85	95.78	12.17	38.78	7.42	44.54	16.03
		2 Σ of Mean		1.72	42.83	5.44	17.34	3.32	19.92	7.17
		% St. Deviation		47.72	40.25	41.42	40.46	40.78	40.34	40.23

APPENDIX B.9.7 continued

Sample Name	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Pb	Th	U
7 Fount 1(c).01	1.70	54.74	10.17	64.04	14.37	31.88	4.68	23.45	2.88	6.71	2.86	4.10
7 Fount 1(c).02	0.86	33.48	6.17	38.78	8.75	19.53	2.85	14.55	1.81	7.02	1.21	2.53
7 Fount 1(c).03	1.57	49.51	8.39	48.93	10.67	22.50	3.03	14.53	1.76	7.25	2.28	2.47
7 Fount 1(c).04	2.05	74.68	13.15	82.40	18.30	39.05	5.55	27.47	3.40	3.63	3.15	4.63
7 Fount 1(c).05	1.15	31.66	5.59	35.35	7.84	17.13	2.51	12.60	1.56	8.13	2.43	2.38
7 Fount 1(c).06	1.37	36.10	6.28	38.83	8.66	19.01	2.81	14.37	1.78	8.14	4.79	2.93
7 Fount 1(c).07	1.01	33.66	5.67	35.26	7.70	16.64	2.28	10.96	1.30	8.43	1.42	1.85
7 Fount 1(c).08	1.19	33.62	5.86	36.99	8.26	18.16	2.68	13.72	1.69	8.27	2.89	2.74
7 Fount 1(c).09	0.71	25.92	4.53	28.06	6.19	13.74	2.00	10.38	1.27	8.50	1.40	1.34
7 Fount 1(c).10	1.17	26.63	4.61	27.64	5.95	12.54	1.72	8.35	1.00	7.25	2.60	1.45
7 Fount 1(c).11	2.33	66.28	11.42	71.41	15.27	33.00	4.95	25.55	3.21	1.23	5.08	2.26
7 Fount 1(c).12	1.65	53.84	9.20	57.63	12.68	27.55	4.10	20.84	2.61	1.13	2.28	1.67
7 Fount 1(c).13	3.26	99.14	16.78	103.52	22.67	49.76	7.46	37.97	4.72	1.13	6.43	4.16
7 Fount 1(c).14	1.12	39.11	6.46	40.73	9.00	19.89	2.89	14.60	1.82	0.64	2.22	1.01
7 Fount 1(c).15	1.39	60.04	9.76	59.30	12.53	26.58	3.66	17.58	2.11	0.79	0.94	1.34
7 Fount 1(c).16	1.29	34.09	5.80	35.09	7.73	16.87	2.44	12.39	1.51	0.58	3.20	1.24
7 Fount 1(c).17	0.94	29.50	5.21	31.98	7.14	15.74	2.31	11.48	1.45	2.34	1.97	0.74
7 Fount 1(c).18	0.88	36.64	6.34	38.87	8.61	18.63	2.77	14.08	1.77	0.91	1.21	1.06
7 Fount 1(c).19	1.34	56.68	9.32	57.24	12.43	26.49	3.82	18.56	2.28	0.68	1.84	1.15
7 Fount 1(c).20	1.64	64.47	11.01	69.25	15.43	33.84	4.97	25.74	3.21	2.76	2.16	1.81
Average	1.43	46.99	8.09	50.06	11.01	23.93	3.47	17.46	2.16	4.28	2.62	2.14
St. Deviation	0.59	19.10	3.23	20.17	4.41	9.57	1.43	7.34	0.92	3.33	1.40	1.12
2 Σ of Mean	0.26	8.54	1.45	9.02	1.97	4.28	0.64	3.28	0.41	1.49	0.63	0.50
% St. Deviation	41.37	40.66	40.01	40.28	40.03	39.99	41.26	42.06	42.71	77.89	53.60	52.27

APPENDIX B.9.8:

Percent relative standard deviation values for each element analyzed during ICP-MS analysis of individual apatite phenocrysts from the Seven Fountains, Virginia K-bentonite layer referred to as 7 Fount 1(c). These percent values are generated during the 16 analytical passes, each with 5 replicate analyses, for each individual crystal analyzed.

Sample Name	P	Ca	Sr	Y	La	Ce	Pr	Nd	Sm	Eu
7 Fount 1(c).01	2.54	2.99	2.64	2.75	10.66	1.76	1.36	2.80	1.89	2.04
7 Fount 1(c).02	2.13	1.16	2.99	2.24	0.71	2.92	1.98	2.22	1.92	1.16
7 Fount 1(c).03	2.45	1.29	3.15	3.11	1.39	2.55	1.14	2.56	1.70	3.63
7 Fount 1(c).04	2.31	1.14	1.45	3.34	2.97	3.75	2.63	3.67	3.09	4.83
7 Fount 1(c).05	3.22	4.43	1.19	2.43	2.75	3.31	2.07	5.26	2.33	2.64
7 Fount 1(c).06	2.10	5.56	2.16	2.71	2.61	2.67	3.61	4.30	3.41	3.16
7 Fount 1(c).07	4.46	1.00	1.49	1.69	2.44	3.41	2.08	3.13	1.66	2.00
7 Fount 1(c).08	2.26	3.83	2.01	12.39	2.05	0.90	1.30	3.59	1.67	2.18
7 Fount 1(c).09	3.41	2.39	1.95	2.75	2.79	1.17	0.84	4.89	2.51	4.92
7 Fount 1(c).10	2.59	3.49	2.54	4.57	2.92	1.89	1.81	4.65	3.23	3.80
7 Fount 1(c).11	4.20	4.43	1.74	3.66	3.91	4.68	4.74	7.86	4.32	2.16
7 Fount 1(c).12	2.16	2.07	2.60	4.59	4.36	1.93	3.27	8.53	4.42	3.43
7 Fount 1(c).13	3.74	1.14	2.40	2.46	5.06	5.54	2.71	5.15	3.95	3.83
7 Fount 1(c).14	2.81	3.77	4.73	5.76	4.45	3.71	3.14	3.74	2.76	2.19
7 Fount 1(c).15	2.65	5.39	2.90	2.41	2.73	2.30	0.97	5.67	1.85	5.31
7 Fount 1(c).16	1.80	3.02	3.96	3.19	3.10	4.89	2.35	1.62	1.85	4.17
7 Fount 1(c).17	3.35	5.55	5.22	3.22	5.34	4.32	4.04	6.46	4.84	5.65
7 Fount 1(c).18	3.08	0.88	5.33	3.54	6.39	4.62	2.73	7.13	2.61	8.16
7 Fount 1(c).19	2.00	3.36	1.74	5.26	5.20	3.28	3.25	6.59	4.57	7.39
7 Fount 1(c).20	5.38	4.21	3.56	2.61	2.50	5.17	3.23	3.01	4.39	4.11

Sample Name	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Pb	Th	U
7 Fount 1(c).01	2.34	2.20	1.52	3.39	2.13	4.26	3.31	2.77	0.58	2.35	2.18
7 Fount 1(c).02	1.51	2.61	2.81	2.50	2.85	1.94	2.50	2.95	0.83	2.79	5.50
7 Fount 1(c).03	2.31	2.18	1.77	1.21	1.60	2.55	2.04	2.31	0.96	5.09	2.59
7 Fount 1(c).04	2.92	1.89	1.44	0.77	1.29	2.34	3.15	1.17	5.05	2.63	4.57
7 Fount 1(c).05	4.08	2.78	4.52	4.06	4.50	2.55	3.74	3.16	0.36	11.71	3.48
7 Fount 1(c).06	3.66	1.63	1.38	2.99	2.56	2.44	2.41	3.00	0.36	3.59	1.80
7 Fount 1(c).07	4.08	3.17	2.39	2.94	4.20	3.21	3.62	2.39	0.30	2.95	3.92
7 Fount 1(c).08	3.60	0.95	1.33	2.91	1.47	2.20	1.63	2.74	0.48	4.30	1.75
7 Fount 1(c).09	2.93	1.57	1.65	1.85	2.10	2.31	2.17	2.98	0.29	2.24	1.62
7 Fount 1(c).10	1.89	3.63	5.07	3.87	4.74	3.06	6.44	2.57	0.91	19.01	10.86
7 Fount 1(c).11	1.78	2.30	2.62	2.43	3.51	3.45	3.36	3.31	5.55	4.08	6.59
7 Fount 1(c).12	4.89	3.15	4.74	2.57	2.07	2.19	5.20	4.24	10.15	7.14	4.73
7 Fount 1(c).13	4.47	1.27	1.39	2.02	3.02	0.96	1.86	1.71	4.90	4.71	157.80
7 Fount 1(c).14	2.81	3.28	2.34	2.49	3.11	4.00	3.19	2.89	5.51	3.93	3.47
7 Fount 1(c).15	2.24	2.46	4.84	2.82	2.52	1.61	1.11	2.10	9.06	9.62	3.53
7 Fount 1(c).16	2.66	2.42	3.23	3.39	4.11	2.20	1.96	5.68	5.73	11.83	4.14
7 Fount 1(c).17	3.39	2.09	3.55	2.56	2.80	2.67	3.25	2.76	4.97	6.08	6.29
7 Fount 1(c).18	2.71	2.47	4.56	1.63	4.46	1.30	3.34	2.72	6.88	13.33	3.74
7 Fount 1(c).19	5.78	1.04	1.30	0.90	2.18	1.67	3.48	2.94	4.73	9.27	3.63
7 Fount 1(c).20	5.22	5.05	5.66	3.02	4.81	4.26	3.83	3.32	2.10	5.10	1.54

APPENDIX B.9.9:

Rare earth element ratios derived from trace element concentration values found in Appendix B.9.7 for individual apatite phenocrysts from the Seven Fountains, Virginia K-bentonite layer referred to as 7 Fount 1(c). Mean, standard deviation, 2 Sigma standard error of the mean, and percent standard deviation values for trace elements are below each ratio.

Sample Name	Ce/La	Ce/Pr	Nd/Pr	Nd/Sm	Gd/Sm	Gd/Tb	Dy/Tb	Dy/Ho	Er/Ho	Er/Tm	Yb/Tm	Yb/Lu
7 Fount 1(c).01	2.92	5.39	6.06	2.87	1.15	5.38	6.30	4.46	2.22	6.82	5.02	8.13
7 Fount 1(c).02	3.11	5.52	5.84	2.82	1.19	5.43	6.29	4.43	2.23	6.86	5.11	8.05
7 Fount 1(c).03	3.25	5.39	5.91	2.74	1.13	5.90	5.83	4.59	2.11	7.42	4.79	8.24
7 Fount 1(c).04	3.20	5.35	6.04	2.72	1.18	5.68	6.26	4.50	2.13	7.04	4.95	8.09
7 Fount 1(c).05	3.17	5.51	5.97	2.79	1.19	5.67	6.33	4.51	2.19	6.81	5.01	8.06
7 Fount 1(c).06	3.15	5.35	6.00	2.85	1.19	5.75	6.19	4.48	2.19	6.77	5.12	8.08
7 Fount 1(c).07	3.11	5.22	6.21	2.86	1.12	5.94	6.22	4.58	2.16	7.30	4.81	8.41
7 Fount 1(c).08	3.14	5.38	5.97	2.80	1.17	5.73	6.31	4.48	2.20	6.78	5.13	8.10
7 Fount 1(c).09	3.19	5.46	5.95	2.82	1.18	5.72	6.20	4.53	2.22	6.87	5.19	8.17
7 Fount 1(c).10	3.31	5.25	6.04	2.69	1.13	5.77	5.99	4.65	2.11	7.27	4.84	8.38
7 Fount 1(c).11	3.26	5.12	6.36	2.79	1.15	5.80	6.25	4.68	2.16	6.67	5.16	7.95
7 Fount 1(c).12	3.26	5.16	6.11	2.77	1.18	5.85	6.27	4.54	2.17	6.72	5.08	7.99
7 Fount 1(c).13	3.24	5.23	5.91	2.78	1.20	5.91	6.17	4.57	2.19	6.67	5.09	8.04
7 Fount 1(c).14	3.56	5.21	6.07	2.72	1.21	6.06	6.31	4.53	2.21	6.87	5.05	8.03
7 Fount 1(c).15	3.55	5.17	6.07	2.78	1.16	6.15	6.08	4.73	2.12	7.26	4.80	8.34
7 Fount 1(c).16	3.56	5.23	6.21	2.64	1.20	5.88	6.05	4.54	2.18	6.90	5.07	8.19
7 Fount 1(c).17	3.41	4.99	6.26	2.70	1.17	5.67	6.14	4.48	2.20	6.82	4.97	7.93
7 Fount 1(c).18	3.44	5.13	6.13	2.73	1.22	5.78	6.13	4.52	2.16	6.72	5.08	7.94
7 Fount 1(c).19	3.40	5.11	6.26	2.73	1.24	6.08	6.14	4.61	2.13	6.94	4.86	8.14
7 Fount 1(c).20	3.37	5.33	6.07	2.78	1.21	5.85	6.29	4.49	2.19	6.81	5.18	8.01
AVERAGE	3.28	5.27	6.07	2.77	1.18	5.80	6.19	4.54	2.17	6.92	5.02	8.11
St. Deviation	0.17	0.14	0.13	0.06	0.03	0.19	0.13	0.08	0.04	0.22	0.13	0.14
2 Σ of Mean	0.08	0.06	0.06	0.03	0.01	0.09	0.06	0.03	0.02	0.10	0.06	0.06
% St. Deviation	5.17	2.71	2.21	2.17	2.68	3.31	2.03	1.68	1.73	3.22	2.62	1.72

APPENDIX B.9.10:

Trace element concentrations obtained from ICP-MS analysis of individual apatite phenocrysts within a K-bentonite layer 7 Fount 3 from Seven Fountains, Virginia. Since individual crystal weights could not be measured, values shown have no units. Average, standard deviation, 2 sigma standard error of the mean, and percent standard deviation values are shown below each analyte used in further analyses.

Sample Name	P	Ca	Ca/P*	Sr	Y	La	Ce	Pr	Nd	Sm
7 Fount 3.01	5841.18	12265.09	0.99	4.14	76.66	10.92	34.96	6.25	38.53	12.49
7 Fount 3.02	3061.86	6532.54	1.01	1.79	54.14	5.57	18.11	3.36	20.34	7.76
7 Fount 3.03	5403.00	11362.17	0.99	3.43	83.98	8.75	28.67	5.25	31.63	11.98
7 Fount 3.04	5855.46	12211.10	0.99	3.85	106.50	11.09	36.31	6.74	40.38	15.15
7 Fount 3.05	7100.79	14413.38	0.96	7.47	94.75	13.99	44.94	7.98	47.80	15.28
7 Fount 3.06	5039.47	10257.52	0.96	3.59	77.95	8.54	27.61	5.00	30.76	10.96
7 Fount 3.07	11317.69	24870.18	1.04	8.15	198.04	20.86	67.34	12.56	76.61	28.03
7 Fount 3.08	7934.97	16157.49	0.96	4.66	126.54	12.28	41.20	7.84	49.24	18.26
7 Fount 3.09	4672.59	9978.93	1.01	3.59	69.13	8.95	27.49	5.07	30.59	10.45
7 Fount 3.10	2891.94	6209.96	1.02	1.99	49.45	5.40	17.62	3.25	20.14	7.57
7 Fount 3.11	2732.62	5974.48	1.03	1.98	51.35	5.28	17.29	3.15	19.00	7.07
7 Fount 3.12	4234.10	9184.76	1.03	2.75	63.47	6.86	22.45	4.19	25.66	9.56
7 Fount 3.13	5632.53	11877.38	1.00	4.37	82.70	9.84	30.33	5.51	34.16	11.83
7 Fount 3.14	19545.63	40837.91	0.99	13.68	337.21	36.44	116.74	21.94	130.81	48.18
7 Fount 3.15	22151.97	46314.53	0.99	15.01	353.73	38.39	123.13	23.33	144.41	51.08
7 Fount 3.16	4040.46	8545.20	1.00	2.99	73.28	7.76	25.84	4.71	29.18	10.85
7 Fount 3.17	5065.58	10668.93	1.00	4.59	82.75	9.18	28.64	5.24	31.58	11.13
7 Fount 3.18	2583.53	5642.37	1.03	2.32	33.83	5.04	15.08	2.81	17.75	5.56
		Average		5.02	111.97	12.51	40.21	7.45	45.48	16.29
		St. Deviation		3.80	92.27	9.82	31.53	5.98	36.37	13.15
		2 Σ of Mean		1.79	43.50	4.63	14.86	2.82	17.14	6.20
		% St. Deviation		75.71	82.41	78.54	78.41	80.24	79.97	80.70

APPENDIX B.9.10 continued

Sample Name	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Pb	Th	U
7 Fount 3.01	0.43	14.56	2.51	15.65	3.48	7.67	1.08	5.12	0.65	-1.87	0.42	1.10
7 Fount 3.02	0.24	9.33	1.67	10.61	2.42	5.29	0.74	3.66	0.47	-1.99	0.25	0.51
7 Fount 3.03	0.43	14.11	2.60	16.23	3.68	7.99	1.13	5.68	0.71	-2.18	0.51	0.96
7 Fount 3.04	0.52	18.38	3.23	20.34	4.58	9.90	1.46	7.10	0.92	-2.15	0.58	1.03
7 Fount 3.05	0.47	18.07	2.99	18.92	4.26	9.22	1.29	6.49	0.79	-0.79	0.60	0.59
7 Fount 3.06	0.33	13.55	2.34	15.01	3.44	7.64	1.11	5.40	0.67	-2.26	0.30	0.79
7 Fount 3.07	0.94	34.12	6.18	39.33	8.96	19.75	2.82	14.10	1.74	-1.67	1.01	1.57
7 Fount 3.08	0.60	22.45	3.95	24.44	5.39	11.65	1.66	8.27	1.04	0.19	0.66	1.31
7 Fount 3.09	0.34	12.45	2.20	13.92	3.10	6.84	0.96	4.91	0.62	0.00	0.58	0.71
7 Fount 3.10	0.26	8.97	1.62	10.38	2.33	5.11	0.73	3.70	0.47	0.00	0.35	0.77
7 Fount 3.11	0.23	8.65	1.57	9.94	2.25	4.97	0.70	3.46	0.44	0.00	0.24	0.66
7 Fount 3.12	0.38	11.49	2.03	12.65	2.71	5.86	0.85	4.30	0.55	0.00	0.66	0.43
7 Fount 3.13	0.38	14.32	2.55	16.33	3.72	8.14	1.18	5.82	0.73	0.00	0.37	0.74
7 Fount 3.14	1.41	58.07	10.27	64.69	14.65	31.81	4.53	22.23	2.81	0.00	1.18	2.59
7 Fount 3.15	1.62	61.40	11.06	70.24	15.85	34.35	4.94	25.02	3.10	0.00	1.25	3.00
7 Fount 3.16	0.36	13.14	2.37	14.84	3.32	7.27	1.05	5.23	0.67	0.00	0.42	0.98
7 Fount 3.17	0.36	12.95	2.42	15.69	3.49	7.69	1.10	5.50	0.70	0.00	0.24	0.58
7 Fount 3.18	0.17	6.34	1.06	6.59	1.49	3.30	0.46	2.29	0.28	0.00	0.21	0.27
Average	0.53	19.57	3.48	21.99	4.95	10.80	1.54	7.68	0.96	-0.71	0.55	1.03
St. Deviation	0.40	15.88	2.85	18.01	4.08	8.85	1.27	6.34	0.79	0.98	0.32	0.72
2 Σ of Mean	0.19	7.49	1.34	8.49	1.92	4.17	0.60	2.99	0.37	0.46	0.15	0.34
% St. Deviation	75.77	81.12	81.76	81.91	82.42	81.89	82.03	82.53	81.88	-139.04	57.75	69.42

APPENDIX B.9.11:

Percent relative standard deviation values for each element analyzed during ICP-MS analysis of individual apatite phenocrysts from the Seven Fountains, Virginia K-bentonite layer referred to as 7 Fount 3. These percent values are generated during 5 replicate analyses of each individual crystal analyzed.

Sample Name	P	Ca	Sr	Y	La	Ce	Pr	Nd	Sm	Eu
7 Fount 3.01	3.81	1.57	1.49	2.24	2.81	1.72	2.57	3.53	3.86	6.16
7 Fount 3.02	2.98	2.94	0.99	2.96	2.33	1.33	2.48	3.60	5.55	3.65
7 Fount 3.03	2.51	3.04	2.34	1.78	4.25	2.89	4.96	5.63	3.71	6.65
7 Fount 3.04	3.24	2.21	1.81	2.71	0.94	1.98	4.33	4.39	2.28	5.50
7 Fount 3.05	3.40	2.61	0.73	1.93	1.27	2.22	3.21	4.21	2.54	6.12
7 Fount 3.06	3.73	1.93	0.73	0.99	1.77	3.58	3.11	6.32	2.99	6.64
7 Fount 3.07	2.91	1.98	0.63	2.99	2.14	2.85	1.23	5.03	1.95	3.86
7 Fount 3.08	2.47	2.67	2.65	4.92	2.20	2.10	1.70	4.66	2.80	2.62
7 Fount 3.09	2.16	3.54	2.98	3.86	2.41	2.74	3.12	5.75	3.26	4.46
7 Fount 3.10	3.36	2.60	3.16	4.17	3.58	2.72	2.28	5.48	1.68	6.31
7 Fount 3.11	5.46	7.15	1.59	3.53	2.20	2.58	0.99	3.23	3.55	3.51
7 Fount 3.12	3.38	4.19	1.74	2.58	1.61	2.69	2.40	6.38	2.54	5.83
7 Fount 3.13	1.97	2.16	2.10	3.91	1.80	3.86	2.05	2.15	2.16	5.43
7 Fount 3.14	4.21	3.45	1.11	2.15	2.12	1.25	2.77	4.33	3.08	2.27
7 Fount 3.15	3.09	2.87	2.18	3.87	1.34	3.03	2.06	1.72	2.35	1.88
7 Fount 3.16	5.08	3.48	1.03	2.00	1.98	1.83	2.47	3.32	3.51	2.03
7 Fount 3.17	2.20	3.94	3.91	3.54	2.23	1.43	2.93	2.62	1.52	3.99
7 Fount 3.18	3.35	3.30	1.87	3.27	1.93	2.42	0.97	3.75	1.45	5.60

Sample Name	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Pb	Th	U
7 Fount 3.01	1.90	2.01	2.41	2.21	2.05	2.33	2.22	1.43	3.96	19.72	3.45
7 Fount 3.02	4.03	0.65	1.99	2.55	3.75	2.26	4.00	2.10	2.36	6.07	6.53
7 Fount 3.03	4.99	2.07	3.11	3.86	6.73	2.82	3.63	1.70	0.73	8.47	4.18
7 Fount 3.04	1.73	1.88	3.10	2.77	2.89	1.90	3.50	2.48	3.23	4.68	3.79
7 Fount 3.05	3.32	2.13	2.51	1.47	5.45	4.53	4.34	1.69	8.66	7.43	2.15
7 Fount 3.06	2.39	1.71	1.70	3.55	2.32	1.62	2.74	2.04	2.38	7.41	5.43
7 Fount 3.07	2.80	1.89	1.45	1.38	3.03	2.46	2.31	3.18	4.50	8.17	3.24
7 Fount 3.08	4.17	2.87	2.64	1.03	4.08	1.87	2.36	3.03	61.80	6.32	4.61
7 Fount 3.09	3.97	2.38	2.91	1.55	2.59	3.04	1.78	2.97	3.26	14.01	1.41
7 Fount 3.10	4.87	2.47	2.48	3.47	3.51	1.67	3.79	2.88	22.61	6.61	4.17
7 Fount 3.11	3.29	2.20	2.93	2.42	2.99	3.51	3.17	0.25	11.24	5.43	4.69
7 Fount 3.12	1.94	3.88	5.73	4.08	4.08	3.78	3.36	2.30	52.80	8.32	1.97
7 Fount 3.13	2.44	2.30	2.44	2.52	1.92	2.04	3.39	3.05	24.02	18.51	3.13
7 Fount 3.14	0.73	3.18	3.07	3.51	4.08	3.59	2.50	2.94	17.40	5.01	3.20
7 Fount 3.15	1.96	2.43	2.72	3.60	4.55	3.96	2.97	2.80	4.64	4.01	1.25
7 Fount 3.16	3.05	1.33	4.03	1.71	4.97	2.49	5.18	3.04	95.41	9.03	3.72
7 Fount 3.17	2.04	1.45	1.34	3.35	3.07	2.81	3.39	2.36	5.16	7.96	2.86
7 Fount 3.18	3.23	2.90	1.44	2.48	1.89	2.64	4.00	5.13	208.65	12.75	5.04

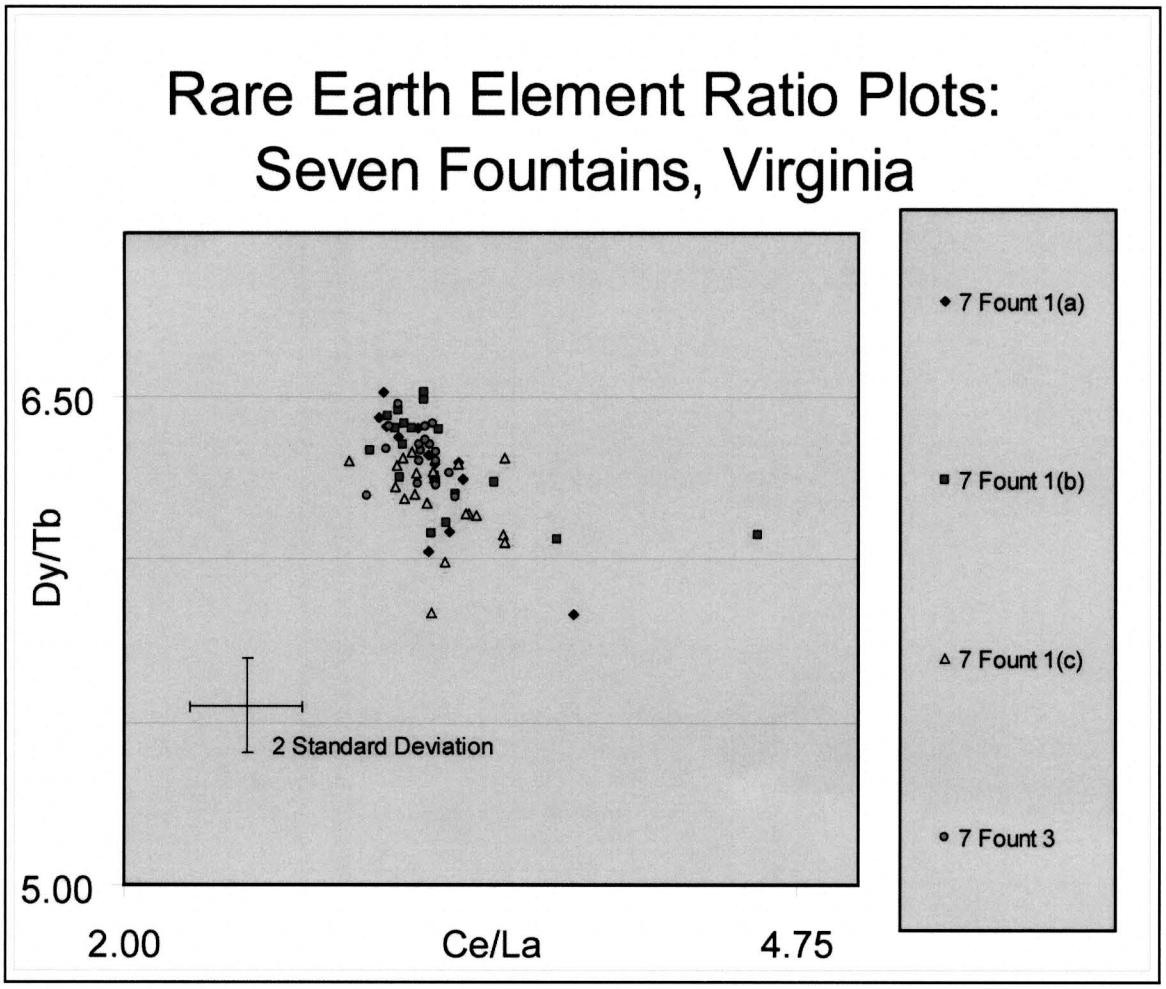
APPENDIX B.9.12:

Rare earth element ratios derived from trace element concentration values found in Appendix B.9.10 for individual apatite phenocrysts from the Seven Fountains, Virginia K-bentonite layer referred to as 7 Fount 1(a). Mean, standard deviation, 2 Sigma standard error of the mean, and percent standard deviation values for trace elements are below each ratio.

Sample Name	Ce/La	Ce/Pr	Nd/Pr	Nd/Sm	Gd/Sm	Gd/Tb	Dy/Tb	Dy/Ho	Er/Ho	Er/Tm	Yb/Tm	Yb/Lu
7 Fount 3.01	3.20	5.59	6.16	3.09	1.17	5.80	6.23	4.50	2.20	7.12	4.76	7.93
7 Fount 3.02	3.25	5.39	6.06	2.62	1.20	5.59	6.35	4.38	2.18	7.11	4.92	7.77
7 Fount 3.03	3.28	5.46	6.02	2.64	1.18	5.42	6.23	4.42	2.17	7.09	5.04	8.03
7 Fount 3.04	3.27	5.39	5.99	2.67	1.21	5.69	6.30	4.44	2.16	6.76	4.85	7.72
7 Fount 3.05	3.21	5.63	5.99	3.13	1.18	6.04	6.33	4.44	2.16	7.12	5.02	8.22
7 Fount 3.06	3.23	5.53	6.16	2.81	1.24	5.78	6.40	4.36	2.22	6.90	4.88	8.11
7 Fount 3.07	3.23	5.36	6.10	2.73	1.22	5.52	6.36	4.39	2.20	7.01	5.01	8.12
7 Fount 3.08	3.35	5.25	6.28	2.70	1.23	5.69	6.19	4.54	2.16	7.00	4.97	7.95
7 Fount 3.09	3.07	5.42	6.03	2.93	1.19	5.67	6.34	4.48	2.20	7.09	5.09	7.93
7 Fount 3.10	3.26	5.42	6.20	2.66	1.18	5.54	6.41	4.46	2.19	6.96	5.04	7.89
7 Fount 3.11	3.27	5.49	6.03	2.69	1.22	5.50	6.33	4.41	2.21	7.07	4.93	7.86
7 Fount 3.12	3.27	5.35	6.12	2.68	1.20	5.65	6.22	4.67	2.16	6.91	5.07	7.87
7 Fount 3.13	3.08	5.50	6.20	2.89	1.21	5.62	6.41	4.39	2.19	6.89	4.93	7.95
7 Fount 3.14	3.20	5.32	5.96	2.72	1.21	5.65	6.30	4.42	2.17	7.03	4.91	7.92
7 Fount 3.15	3.21	5.28	6.19	2.83	1.20	5.55	6.35	4.43	2.17	6.95	5.06	8.06
7 Fount 3.16	3.33	5.49	6.20	2.69	1.21	5.55	6.26	4.47	2.19	6.91	4.96	7.83
7 Fount 3.17	3.12	5.47	6.03	2.84	1.16	5.34	6.47	4.50	2.21	7.01	5.02	7.82
7 Fount 3.18	2.99	5.37	6.32	3.19	1.14	5.96	6.19	4.43	2.22	7.17	4.98	8.13
AVERAGE	3.21	5.43	6.11	2.80	1.20	5.64	6.32	4.45	2.19	7.01	4.97	7.95
St. Deviation	0.09	0.10	0.11	0.18	0.02	0.17	0.08	0.07	0.02	0.11	0.09	0.14
2 Σ of Mean	0.04	0.05	0.05	0.08	0.01	0.08	0.04	0.03	0.01	0.05	0.04	0.06
% St. Deviation	2.90	1.86	1.73	6.27	2.08	3.09	1.28	1.61	0.91	1.53	1.73	1.72

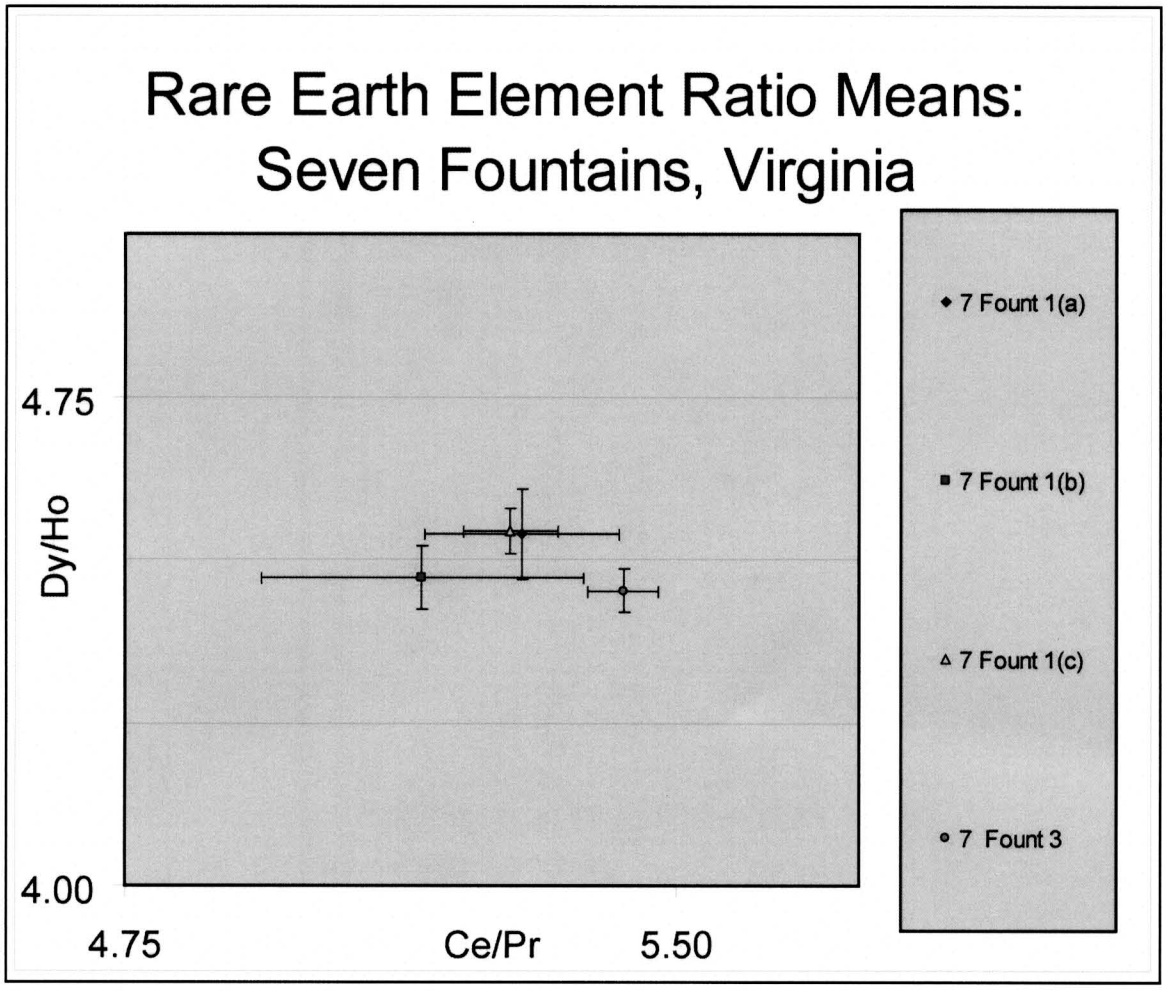
APPENDIX B.10.1:

Rare earth element ratios plots for all K-bentonite layers analyzed from Locality G. Analytes in this plot are Cerium, Lanthanum, Dysprosium, and Terbium. Scale and legend are given.



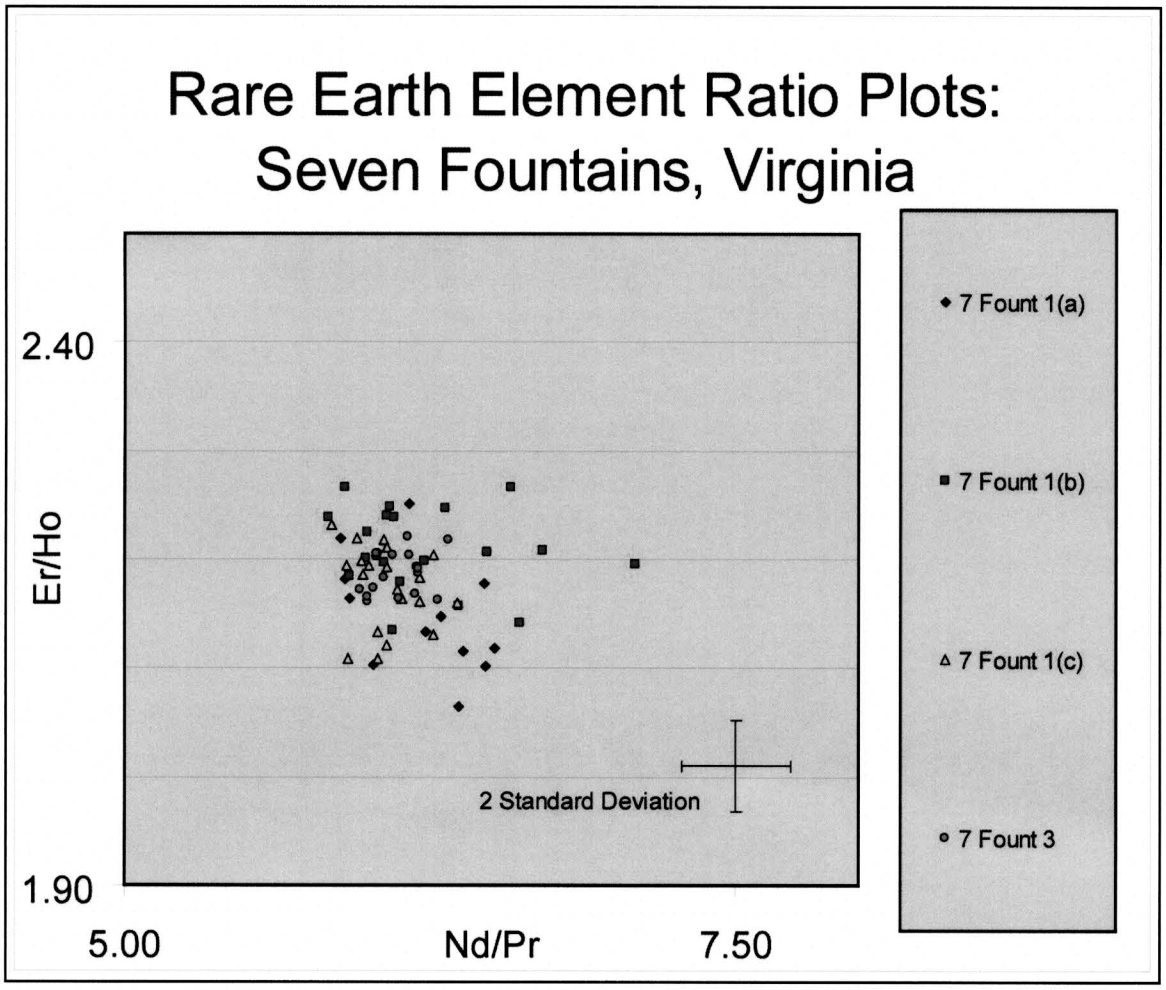
APPENDIX B.10.2:

Mean rare earth element ratios plots for all K-bentonite layers analyzed from Localities C and D. Analytes in this plot are Cerium, Praseodymium, Dysprosium, and Holmium. Error bars are 2 sigma standard error of the mean. Scale has been exaggerated for easier viewing. Scale and legend are given



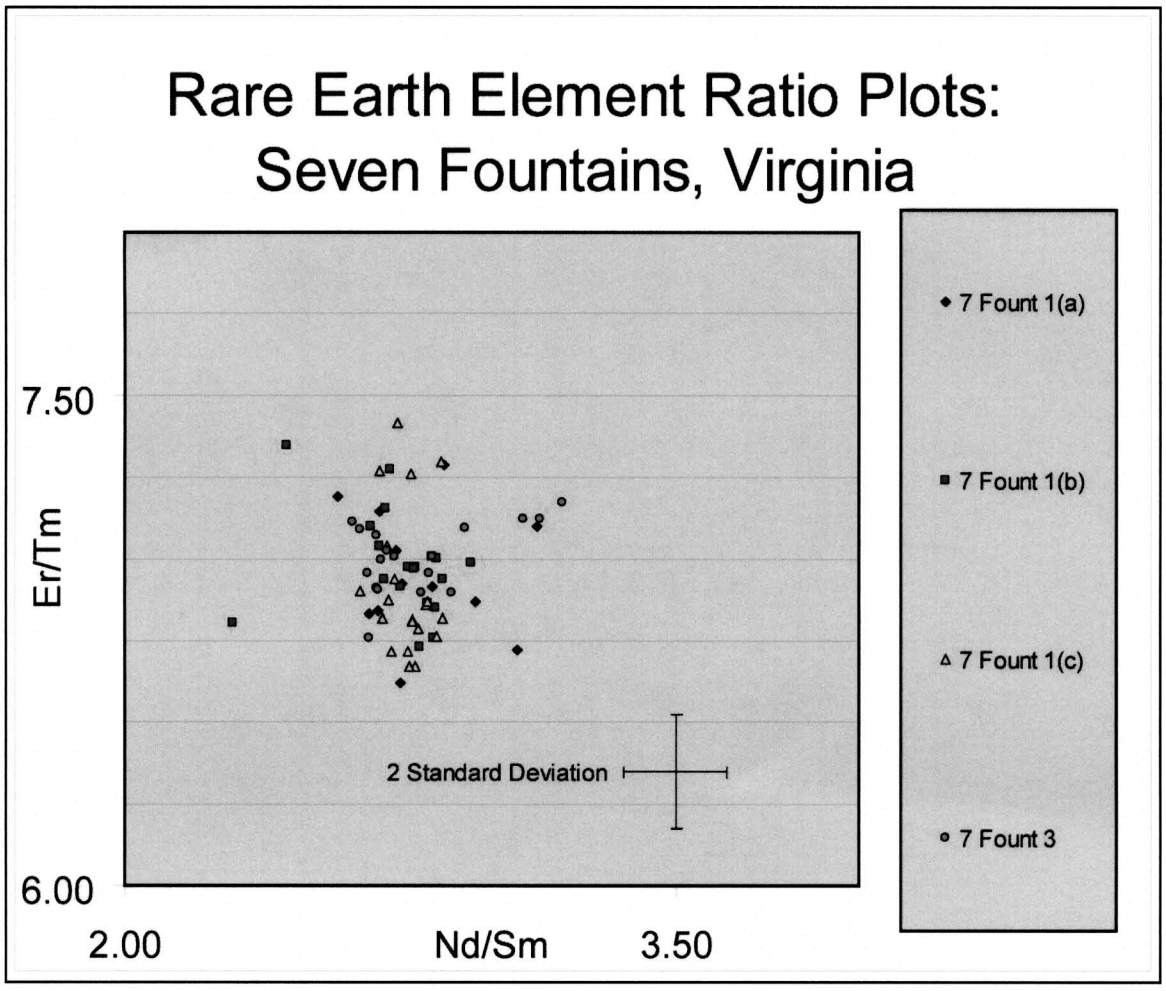
APPENDIX B.10.3:

Rare earth element ratios plots for all K-bentonite layers analyzed from Locality G. Analytes in this plot are Neodymium, Praseodymium, Erbium, and Holmium. Scale and legend are given.



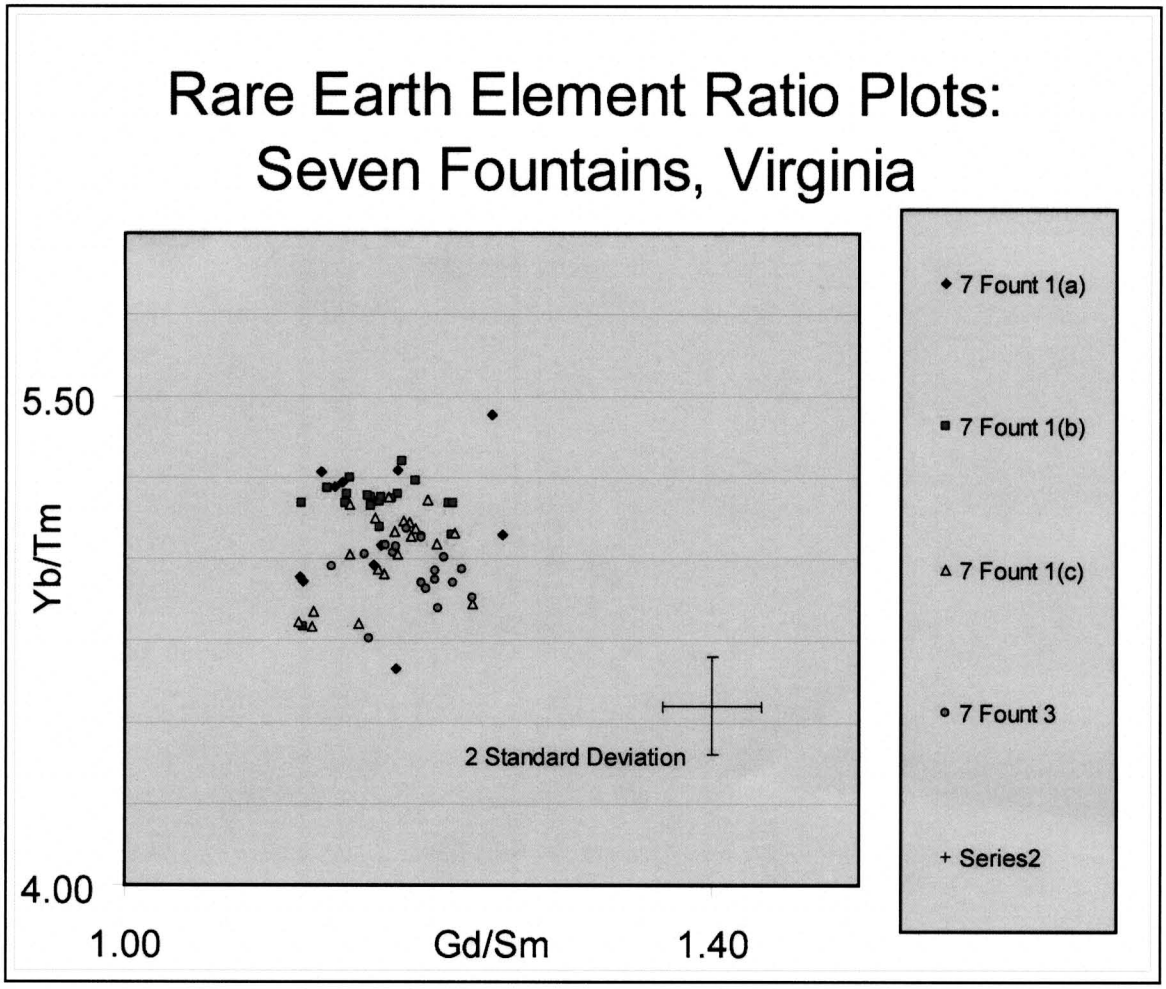
APPENDIX B.10.4:

Rare earth element ratios plots for all K-bentonite layers analyzed from Locality G. Analytes in this plot are Neodymium, Samarium, Erbium, and Thulium. Scale and legend are given.



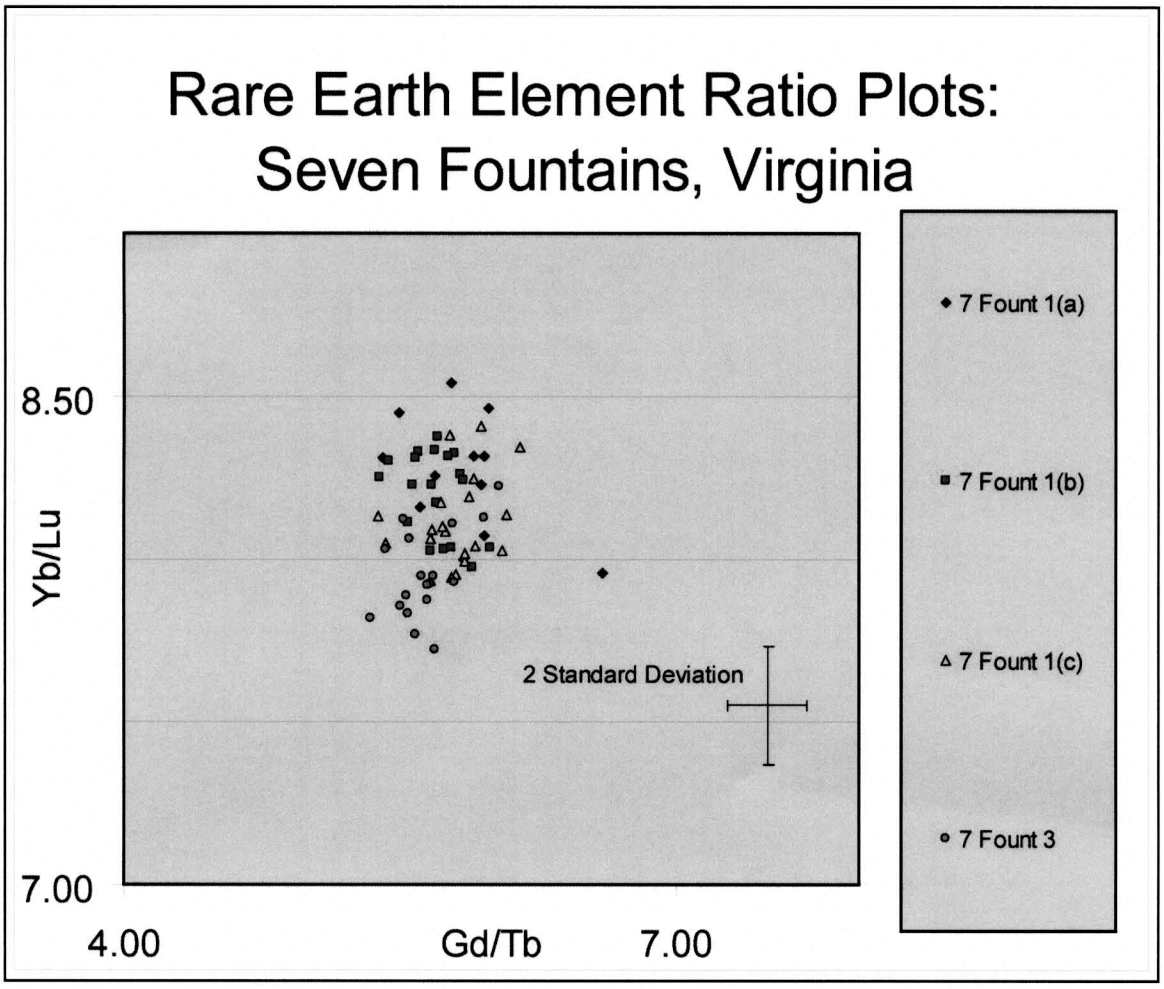
APPENDIX B.10.5:

Rare earth element ratios plots for all K-bentonite layers analyzed from Locality G. Analytes in this plot are Gadolinium, Samarium, Ytterbium, and Thulium. Scale and legend are given.



APPENDIX B.10.6:

Rare earth element ratios plots for all K-bentonite layers analyzed from Locality G. Analytes in this plot are Gadolinium, Terbium, Ytterbium, and Lutetium. Scale and legend are given.



APPENDIX B.10.7:

Mean plots of Heavy REE versus Light REE for all layers sampled at Locality G in order to distinguish magma characteristics within layers from the same locality. Separate populations indicate the La/Lu enrichment in a given layer, therefore implicating varying magma geochemistry within a single layer. 2 Sigma error bars are shown.