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Title of article Open System, Constant Volume Development of Slaty Cleavage, and Strain Induced Replacement Reactions in the Martinsburg Formation, Lehigh Gap, PA

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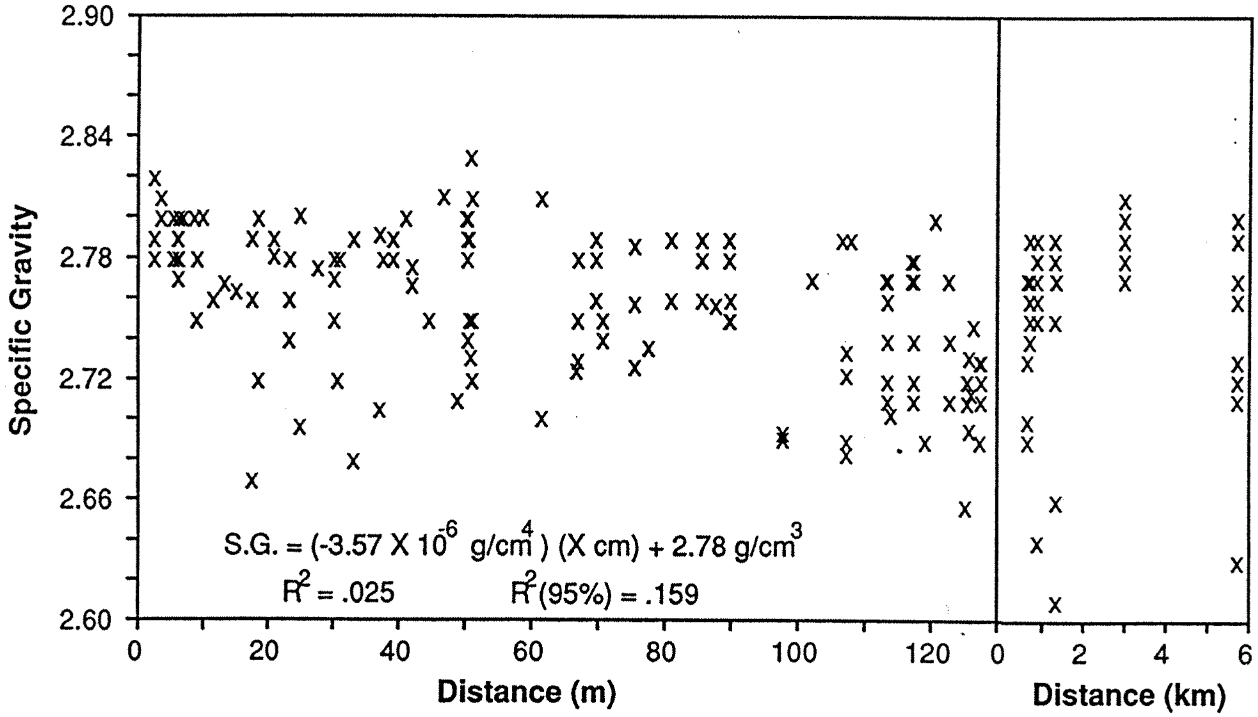
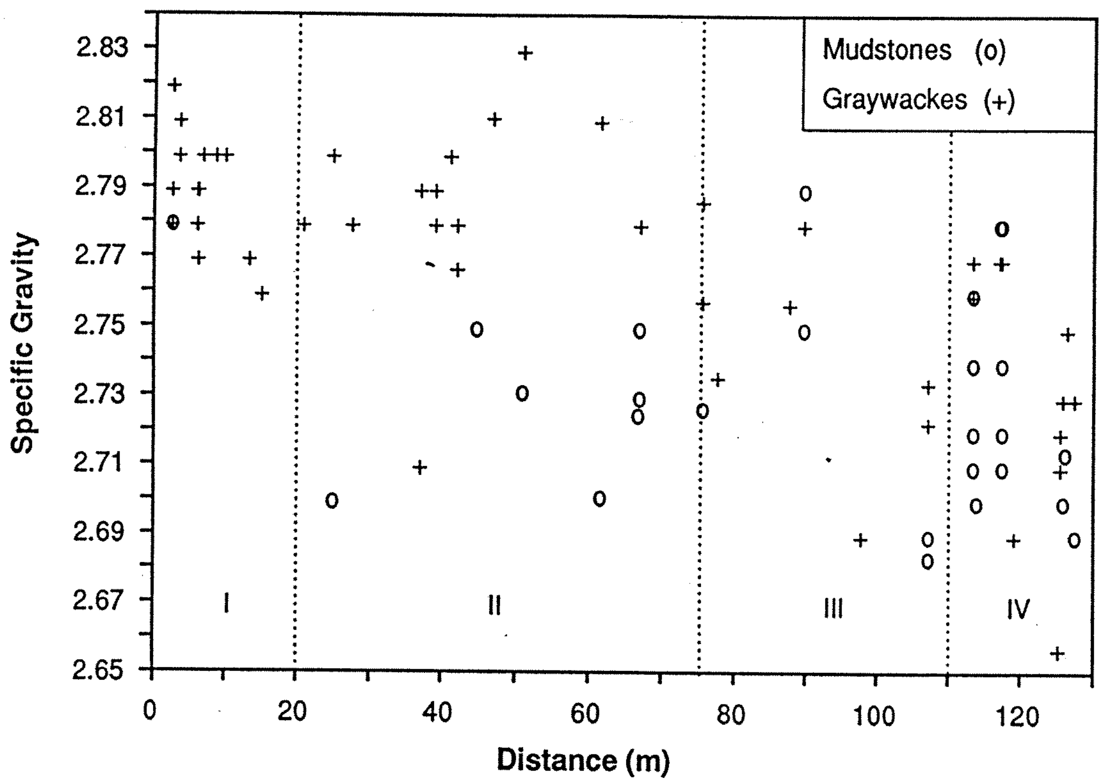


Appendix 1a. Specific gravity measurements of samples of mudstone/slate and graywacke/metagraywacke plotted against distance from the Martinsburg-Shawangunk contact, showing 179 measurements and the regression of 144 samples from Lehigh Gap.



Appendix 1b. The variation of specific gravity of mudstone/slate and graywacke/metagraywacke with distance in samples from Lehigh Gap that were also analyzed for chemical composition.

Appendix 2. Chemical Analyses of Rocks from the Pen Argyl Member, Martinsburg Formation, Lehigh Gap Area, Pennsylvania.

Sample	3A	3B	3C	3D	4A	4B	4C	6.5-1
[1]Meters	3.0	3.0	3.0	3.0	4.0	4.0	4.0	6.5
[2]Sp. Gr.	2.78	2.79	2.78	2.82	2.81	2.80	2.80	2.79
[3]Rock Type	ss	ms	ms	ms	ms	ms	ms	ms
				[4]Major Elements				
SiO_2	65.1	62.2	63.4	63.3	60.7	60.9	61.6	61.7
TiO_2	1.16	1.13	1.14	0.88	1.11	1.19	1.09	1.17
Al_2O_3	16.00	18.07	17.70	13.75	17.15	17.35	16.95	18.00
[5]FeO			2.83	3.88				
[5]Fe_2O_3			2.22	6.18				
FeO_T	5.12	5.28			6.64	6.53	6.47	5.63
MnO	0.032	0.033	0.033	0.040	0.049	0.047	0.048	0.038
MgO	2.69	2.50	2.61	3.03	3.60	3.61	3.53	2.79
CaO	0.12	0.08	0.00	0.02	0.18	0.33	0.00	0.26
Na_2O	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.06
K_2O	4.08	4.84	4.69	3.02	4.39	4.56	4.42	4.81
P_2O_5	0.72	0.57	0.93	0.51	0.54	0.41	0.75	0.22
[6]LOI	4.23	4.63	4.53	4.80	4.35	4.21	4.22	4.83
Subtotal	99.28	99.37	100.04	99.36	98.70	99.14	99.03	99.51
				[7]Trace Elements				
Ba	754	953	910	610	879	885	891	922
Sr	14	12	13	25	21	30	22	14
V	171	162	140	125	175	177	182	167
Y	15	23	22	23	15	22	22	17
Zn	107	23	63	96	14	18	41	170
[8]Rb			176	111				
[8]Zr			256	181				
[9]Org C			0.174	0.173				
[9]Carb C			0.023	0.015				
[9]Total C			0.197	0.188				
[9]Total S			0.020	0.021				

Appendix 2. Continued

Sample	6.5-2	6.6-1	6.6-2	24	30	34	45	51
[1]Meters	6.5	6.6	6.6	7.3	9.1	10.4	13.7	15.5
[2]Sp. Gr.	2.78	2.79	2.77	2.80	2.80	2.80	2.77	2.76
[3]Rock Type	ms	ms	ms	ms	ms	ms	ms	ms
				[4]Major Elements				
SiO_2	62.5	61.4	63.8	60.6	62.0	60.8	60.7	62.1
TiO_2	1.14	1.11	1.14	1.13	1.03	1.07	1.05	1.11
Al_2O_3	17.40	16.80	16.80	17.95	17.75	17.69	17.64	17.68
[5]FeO		3.38	3.38					
[5]Fe_2O_3		3.51	3.38					
FeO_T	5.69			7.19	6.51	6.71	7.36	6.09
MnO	0.035	0.035	0.039	0.048	0.040	0.043	0.043	0.038
MgO	2.69	2.89	2.74	3.08	2.82	2.90	2.95	2.63
CaO	0.43	0.04	0.33	0.07	0.02	0.02	0.08	0.15
Na_2O	0.06	0.00	0.05	0.04	0.03	0.05	0.04	0.04
K_2O	4.61	4.40	4.19	4.60	4.70	4.60	4.41	4.37
P_2O_5	0.20	0.58	0.28	0.30	0.24	0.26	0.26	0.14
[6]LOI	4.78	4.64	4.61	4.91	5.04	5.30	5.22	5.89
Subtotal	99.54	98.73	100.77	99.87	100.13	99.46	99.71	100.17
				[7]Trace Elements				
Ba	905	860	830	885	885	926	868	882
Sr	22	12	12	37	21	31	20	38
V	157	148	144	145	144	146	148	134
Y	17	23	22	45	33	36	39	36
Zn	212	276	285	193	244	176	351	211
[8]Rb		172	149					
[8]Zr		241	240					
[9]Org C		0.165	0.145					
[9]Carb C		0.002	0.017					
[9]Total C		0.167	0.162					
[9]Total S		0.019	0.018					

Appendix 2. Continued

Sample	70	83A	83B	92	123A	123B	39.5-1	39.5-2
[1]Meters	21.3	25.3	25.3	28.0	37.5	37.5	39.5	39.5
[2]Sp. Gr.	2.78	2.80	2.70	2.78	2.79	2.71	2.79	2.78
[3]Rock Type	ms	ms	ss	ms	ms	ms	ms	ms
				[4]Major Elements				
SiO_2	58.1	58.4	74.9	58.8	64.0	65.7	60.8	60.8
TiO_2	1.06	1.12	0.95	0.99	1.14	1.09	1.17	1.09
Al_2O_3	18.12	17.95	10.68	17.55	16.77	15.23	17.43	17.23
[5]FeO		1.99	1.76					
[5]Fe_2O_3		6.87	3.10					
FeO_T	7.96			7.39	7.02	6.48	7.43	7.24
MnO	0.068	0.043	0.028	0.034	0.041	0.039	0.043	0.040
MgO	2.84	2.39	1.66	2.52	2.71	2.37	3.54	3.14
CaO	0.12	0.09	0.18	0.14	0.23	0.18	0.50	0.32
Na_2O	0.11	0.16	0.70	0.11	0.51	0.77	0.72	0.74
K_2O	4.72	4.51	2.07	4.42	3.97	3.46	4.10	4.06
P_2O_5	0.24	0.28	0.23	0.26	0.20	0.25	0.26	0.26
[6]LOI	6.21	5.86	3.74	6.40	5.21	4.80	4.81	4.83
Subtotal	99.49	99.69	99.99	98.55	101.75	100.29	100.81	99.78
				[7]Trace Elements				
Ba	979	940	440	964	864	715	876	950
Sr	22	13	26	20	32	32	33	27
V	135	152	79	148	142	120	162	144
Y	50	29	26	43	41	45	26	25
Zn	186	618	291	296	547	420	68	59
[8]Rb		162	79					
[8]Zr		215	331					
[9]Org C		0.217	0.055					
[9]Carb C		0.007	0.028					
[9]Total C		0.223	0.083					
[9]Total S		0.019	0.022					

Appendix 2. Continued

Sample	136	139A	139B	45	155	168A	168B	203A-1
[1]Meters	41.5	42.4	42.4	45.0	47.2	51.2	51.2	61.9
[2]Sp. Gr.	2.80	2.77	2.78	2.75	2.81	2.83	2.73	2.81
[3]Rock Type	ms	ms	ms	ss	ms	ms	ss	ms
				[4]Major Elements				
SiO_2	60.6	62.7	59.9	59.2	60.8	54.4	75.1	61.6
TiO_2	1.16	1.14	1.16	0.80	1.11	1.14	0.81	1.12
Al_2O_3	17.35	17.85	16.58	10.10	17.70	19.90	10.43	16.73
[5]FeO						4.78	3.09	
[5]Fe_2O_3						3.85	2.36	
FeO_T	7.53	5.39	9.10	6.57	6.77			7.12
MnO	0.050	0.038	0.038	0.363	0.039	0.054	0.031	0.039
MgO	3.10	2.56	2.31	2.35	2.90	3.58	1.89	2.53
CaO	0.19	0.02	0.05	8.80	0.38	0.59	0.23	0.12
Na_2O	0.71	0.69	0.68	1.11	0.67	0.22	1.38	0.80
K_2O	4.29	4.42	4.02	1.93	4.39	5.15	1.79	3.98
P_2O_5	0.31	0.24	0.29	0.26	0.34	0.42	0.26	0.30
[6]LOI	4.58	4.93	6.00	9.63	5.05	5.80	2.78	5.76
Subtotal	99.82	99.98	100.06	101.11	100.15	99.83	100.15	100.10
				[7]Trace Elements				
Ba	899	876	847	366	876	1080	350	810
Sr	33	24	24	73	48	59	39	28
V	143	141	130	90	150	187	73	147
Y	38	32	40	36	47	41	21	50
Zn	341	151	269	78	57	484	207	849
[8]Rb						176	54	
[8]Zr						210	264	
[9]Org C						0.318	0.069	
[9]Carb C						0.008	0.012	
[9]Total C						0.326	0.082	
[9]Total S						0.019	0.01	

Appendix 2. Continued

Sample	203A-2	320	67.3-1	67.3-2	67.4	349A	349B	349C
[1]Meters	61.9	67.1	67.3	67.3	67.4	75.9	75.9	75.9
[2]Sp. Gr.	2.70	2.73	2.75	2.73	2.78	2.79	2.73	2.76
[3]Rock Type	ss	ss	ss	ss	ms	sl	qt	sl
			[4]Major Elements					
SiO_2	78.2	76.6	70.2	73.7	60.4	60.5	66.6	60.6
TiO_2	0.81	0.67	0.83	0.69	1.08	1.03	1.49	1.14
Al_2O_3	9.36	9.81	13.00	11.20	17.70	16.45	12.13	17.90
[5]FeO								
[5]Fe_2O_3								
FeO_T	4.59	4.61	5.68	5.15	7.37	8.87	7.92	6.51
MnO	0.030	0.026	0.034	0.042	0.040	0.043	0.062	0.036
MgO	1.52	1.70	2.90	2.41	3.54	2.78	1.99	2.34
CaO	0.15	0.16	0.39	0.20	0.08	0.03	0.14	0.01
Na_2O	1.54	1.43	1.42	1.56	0.58	0.59	1.35	0.72
K_2O	1.46	1.61	2.55	1.92	4.24	3.79	2.23	4.33
P_2O_5	0.26	0.25	0.34	0.26	0.26	0.29	0.34	0.20
[6]LOI	2.59	2.64	3.08	2.66	4.72	5.44	4.81	5.47
Subtotal	100.46	99.51	100.42	99.79	99.98	99.81	99.09	99.26
			[7]Trace Elements					
Ba	222	275	430	331	791	619	335	684
Sr	45	38	50	43	25	20	39	26
V	65	72	108	85	171	151	101	152
Y	25	25	25	17	25	47	77	35
Zn	151	209	152	143	168	210	110	81
[8]Rb								
[8]Zr								
[9]Org C								
[9]Carb C								
[9]Total C								
[9]Total S								

Appendix 2. Continued

Sample	356	389	90.1-1A	90.1-1B	90.1-2	422A	422B	453A-1
[1]Meters	78.0	88.1	90.1	90.1	90.1	98.1	98.1	107.6
[2]Sp. Gr.	2.74	2.76	2.78	2.79	2.75	2.69	2.69	2.72
[3]Rock Type	sl	sl	sl	qt	qt	sl	sl	sl
				[4]Major Elements				
SiO_2	59.2	60.9	58.0	63.7	60.2	63.8	58.7	61.2
TiO_2	1.23	0.97	0.89	1.15	1.22	1.63	1.66	1.13
Al_2O_3	17.37	16.95	15.10	14.47	17.65	18.72	19.37	17.15
[5]FeO								
[5]Fe_2O_3								
FeO_T	7.72	6.92	7.42	9.14	7.21	3.15	6.69	6.73
MnO	0.042	0.044	0.033	0.035	0.034	0.020	0.029	0.034
MgO	2.76	2.48	2.69	2.55	3.20	1.16	1.66	2.42
CaO	0.01	0.06	0.04	0.07	0.09	0.04	0.02	0.00
Na_2O	0.50	0.45	0.42	0.88	0.94	0.36	0.06	0.24
K_2O	4.28	3.92	3.38	2.96	3.96	4.65	5.22	4.10
P_2O_5	0.24	0.24	0.22	0.29	0.26	0.11	0.25	0.20
[6]LOI	6.04	6.04	5.30	5.12	5.19	6.15	6.52	6.41
Subtotal	99.39	98.97	93.51	100.36	99.91	99.79	100.17	99.61
				[7]Trace Elements				
Ba	644	636	566	478	643	698	795	637
Sr	21	20	18	28	32	26	17	16
V	143	143	137	138	135	139	165	149
Y	41	46	25	29	33	28	45	49
Zn	156	895	346	355	314	201	362	327
[8]Rb								
[8]Zr								
[9]Org C								
[9]Carb C								
[9]Total C								
[9]Total S								

Appendix 2. Continued

Sample	453A-2	453B	453C	113.8-A1	113.8-A2	113.8-A3	113.8-B1	113.8-B2
[1]Meters	107.6	107.6	107.6	113.8	113.8	113.8	113.8	113.8
[2]Sp. Gr.	2.68	2.69	2.73	2.76	2.77	2.77	2.74	2.71
[3]Rock Type	qt	qt	sl	sl	sl	sl	qt	qt
				[4]Major Elements				
SiO_2	56.2	76.1	61.5	69.3	67.8	63.8	65.4	71.8
TiO_2	1.39	0.77	1.08	0.85	0.85	1.11	1.18	0.91
Al_2O_3	19.90	10.45	16.85	13.20	13.12	14.95	14.93	11.13
[5]FeO								
[5]Fe_2O_3								
FeO_T	7.02	4.47	7.10	6.23	6.27	6.35	6.58	5.80
MnO	0.043	0.028	0.038	0.030	0.031	0.032	0.045	0.068
MgO	2.44	1.49	2.87	2.58	2.64	2.67	2.72	2.30
CaO	0.01	0.18	0.05	0.08	0.08	0.15	0.20	0.15
Na_2O	0.66	1.02	0.04	0.90	0.88	1.24	1.46	1.30
K_2O	5.01	1.97	4.13	2.74	2.76	3.34	3.17	2.10
P_2O_5	0.26	0.18	0.16	0.19	0.21	0.25	0.29	0.25
[6]LOI	6.79	3.39	5.58	3.82	3.83	4.33	3.57	2.89
Subtotal	99.72	100.05	99.40	99.89	98.48	98.20	99.55	98.66
				[7]Trace Elements				
Ba	746	314	622	406	407	474	454	300
Sr	27	34	21	24	24	35	44	37
V	145	58	159	128	290	127	122	92
Y	45	21	38	25	22	27	31	31
Zn	216	210	430	53	370	50	54	84
[8]Rb								
[8]Zr								
[9]Org C								
[9]Carb C								
[9]Total C								
[9]Total S								

Appendix 2. Continued

Sample	113.8-B3	113.8-B4	475A	117.5-2	117.5-3	117.8-A1	117.8-A2	117.8-A3
[1]Meters	113.8	113.8	114.3	117.5	117.5	117.8	117.8	117.8
[2]Sp. Gr.	2.72	2.76	2.70	2.77	2.78	2.71	2.74	2.72
[3]Rock Type	qt	qt	qt	sl	qt	qt	qt	qt
			[4]Major Elements					
SiO_2	71.9	62.4	71.9	66.0	58.2	68.9	68.7	74.1
TiO_2	0.89	1.28	0.70	0.92	1.87	0.98	0.98	0.89
Al_2O_3	11.43	16.67	11.50	14.70	19.15	11.90	13.20	10.60
[5]FeO	3.34	3.35						1.84
[5]Fe_2O_3	2.89	3.41						3.48
FeO_T			6.96	6.44	6.26	7.14	5.69	
MnO	0.084	0.041	0.032	0.029	0.120	0.319	0.028	0.036
MgO	2.37	2.86	2.31	2.53	2.79	2.09	2.12	1.89
CaO	0.15	0.19	0.01	0.01	0.05	0.03	0.09	0.08
Na_2O	1.23	1.43	0.10	0.51	1.06	1.06	0.77	1.10
K_2O	2.21	3.87	2.36	3.22	4.59	2.19	2.68	1.77
P_2O_5	0.27	0.30	0.19	0.20	0.30	0.25	0.24	0.28
[6]LOI	2.92	4.08	4.34	4.80	5.54	4.19	4.17	3.24
Subtotal	99.65	99.84	100.35	99.35	99.91	99.03	98.69	99.24
			[7]Trace Elements					
Ba	350	530	379	516	737	439	403	280
Sr	37	41	13	15	30	36	28	32
V	90	137	103	129	139	96	97	80
Y	37	33	28	28	36	39	21	24
Zn	106	68	149	856	820	771	638	562
[8]Rb	85	138						69
[8]Zr	258	305						305
[9]Org C	0.078	0.142						
[9]Carb C	0.012	0.018						
[9]Total C	0.089	0.161						0.050
[9]Total S	0.016	0.021						0.020

Appendix 2. Continued

Sample	117.8-A4	117.8-B	492A	512A	513A	513B	514A	514B
[1]Meters	117.8	117.8	119.5	125.6	125.9	125.9	126.2	126.2
[2]Sp. Gr.	2.78	2.77	2.69	2.66	2.72	2.71	2.73	2.70
[3]Rock Type	qt	sl	sl	sl	sl	sl	sl	qt
				[4]Major Elements				
SiO_2	65.4	68.9	65.1	63.7	68.9	63.2	68.3	70.2
TiO_2	1.14	0.77	0.93	0.92	0.93	1.34	0.65	1.06
Al_2O_3	14.90	12.30	16.18	15.20	14.10	17.65	13.03	13.38
[5]FeO	1.50							
[5]Fe_2O_3	4.94							
FeO_T		7.17	6.25	5.82	5.63	6.17	7.09	5.23
MnO	0.031	0.031	0.026	0.030	0.033	0.066	0.036	0.052
MgO	2.05	2.36	2.41	2.29	2.39	2.93	2.78	2.27
CaO	0.19	0.03	0.02	0.01	0.07	0.01	0.07	0.03
Na_2O	0.99	0.42	0.05	0.03	0.75	0.96	0.56	1.29
K_2O	3.25	2.47	3.59	3.54	3.04	3.94	2.60	2.50
P_2O_5	0.28	0.27	0.24	0.27	0.21	0.22	0.20	0.21
[6]LOI	4.39	4.29	6.16	5.48	4.42	5.05	4.66	4.17
Subtotal	98.99	98.94	100.94	97.29	100.41	101.47	99.90	100.33
				[7]Trace Elements				
Ba	490	374	513	569	438	565	375	360
Sr	31	14	8	12	24	26	18	33
V	118	116	129	140	115	138	118	103
Y	30	19	40	32	26	39	30	25
Zn	1078	651	217	126	87	90	68	77
[8]Rb	117							106
[8]Zr	291							258
[9]Org C	0.097							
[9]Carb C	0.005							
[9]Total C	0.102							0.098
[9]Total S	0.014							0.016

Appendix 2. Continued

Sample	515	516A	127.8-1	127.8-2	WC-1A-1	WC-1A-2	WC-1D-1	WC-1D-2
[1]Meters	126.5	126.8	127.8	127.8	1415.0	1415.0	1413.0	1413.0
[2]Sp. Gr.	2.71	2.75	2.73	2.69	2.54	2.77	2.77	2.66
[3]Rock Type	qt	sl	sl	qt	qt	sl	sl	qt
				[4]Major Elements				
SiO_2	59.2	62.6	65.7	65.5	73.5	66.3	62.7	64.6
TiO_2	1.23	1.14	0.95	1.82	0.89	0.84	0.97	1.02
Al_2O_3	19.07	17.00	15.35	15.85	11.95	14.70	15.40	15.80
[5]FeO	3.53				2.70	3.28	2.67	3.13
[5]Fe_2O_3	3.63				2.24	3.01	5.08	2.83
FeO_T		6.64	6.10	5.71				
MnO	0.038	0.040	0.033	0.036	0.023	0.028	0.027	0.029
MgO	2.74	2.70	2.31	1.94	1.66	2.27	2.05	2.13
CaO	0.03	0.17	0.02	0.04	0.03	0.01	0.01	0.01
Na_2O	0.70	1.03	0.03	0.57	1.57	0.66	1.22	1.33
K_2O	4.57	3.77	3.58	3.41	2.18	3.28	3.26	3.31
P_2O_5	0.28	0.25	0.17	0.31	0.20	0.17	0.23	0.16
[6]LOI	5.63	4.88	4.87	4.83	2.81	4.37	5.20	4.06
Subtotal	100.64	100.21	99.11	100.00	99.75	98.85	98.81	98.39
				[7]Trace Elements				
Ba	640	545	558	505	300	490	440	460
Sr	26	32	15	23	31	15	23	26
V	152	135	126	122	82	129	127	123
Y	34	34	27	30	22	23	27	25
Zn	159	104	388	334	58	79	81	85
[8]Rb	174				93	136	133	140
[8]Zr	279				283	173	168	223
[9]Org C	0.272				0.044	0.287	0.427	0.062
[9]Carb C	0.013				0.025	0.000	0.041	0.010
[9]Total C	0.285				0.069	0.287	0.468	0.072
[9]Total S	0.019				0.015	0.025	0.031	0.012

Appendix 2. Continued

Sample	WC-1F-1	Q2-1	Q3-A	Q3-B	Q3-C2	Q4	T-4-1	T-4-2
[1]Meters	1384.0	3078.5	3078.5	3078.5	3078.5	3078.5	5791.2	5791.2
[2]Sp. Gr.	2.78	2.36	2.79	2.78	2.80	2.77	2.77	2.63
[3]Rock Type	sl	qt	sl	sl	sl	qt	sl	qt
				[4]Major Elements				
SiO_2	59.0	74.3	52.8	50.9	56.5	59.0	58.7	68.3
TiO_2	1.02	0.53	0.74	0.44	0.76	0.43	0.96	0.75
Al_2O_3	17.17	10.07	14.85	12.00	15.45	7.43	19.85	13.55
[5]FeO	6.01	1.18			3.60	3.64	2.83	2.01
[5]Fe_2O_3	3.37	3.63			2.45	1.07	3.25	4.09
FeO_T			5.31	6.32				
MnO	0.043	0.127	0.080	0.090	0.057	0.182	0.026	0.085
MgO	3.36	1.22	2.99	2.51	2.54	3.28	3.03	2.35
CaO	0.12	0.03	6.34	8.72	4.70	9.44	0.31	0.34
Na_2O	0.92	1.78	1.25	1.00	1.16	1.41	0.48	1.26
K_2O	3.36	1.29	3.14	2.47	3.36	1.17	5.43	2.78
P_2O_5	0.27	0.31	0.16	0.18	0.19	0.23	0.27	0.23
[6]LOI	4.98	2.64	10.04	13.27	8.14	12.53	5.10	3.88
Subtotal	99.65	97.11	97.69	97.84	98.90	99.75	100.18	99.62
				[7]Trace Elements				
Ba	480	250	531	405	560	190	810	410
Sr	30	42	221	339	170	278	21	34
V	161	53	89	75	107	41	139	86
Y	30	26	19	19	25	25	26	26
Zn	173	55	84	26	80	31	71	137
[8]Rb	157	51			142	61	224	113
[8]Zr	186	319			148	239	196	192
[9]Org C	0.419	0.043			0.292	0.062	0.211	0.046
[9]Carb C	0.005	0.016			1.063	3.105	0.000	0.023
[9]Total C	0.424	0.059			1.355	3.167	0.211	0.069
[9]Total S	0.021	0.011			0.966	0.238	0.019	0.017

Appendix 2. Continued

Sample	T-5-2	T-6	T-7	T-8	T-11D-1	T-11D-2
[1]Meters	5791.2	5791.2	5791.2	5791.2	5791.2	5791.2
[2]Sp. Gr.	3.75	2.72	2.80	2.73	2.77	2.73
[3]Rock Type	sl	qt	sl	sl	sl	qt
			[4]Major Elements			
SiO_2	59.5	60.0	58.3	59.5	67.0	66.0
TiO_2	0.99	0.37	1.03	0.39	0.61	0.37
Al_2O_3	19.05	6.83	19.35	7.99	11.53	7.43
[5]FeO					3.62	2.88
[5]Fe_2O_3					1.70	1.19
FeO_T	6.04	3.14	6.56	3.85		
MnO	0.029	0.123	0.030	0.122	0.055	0.091
MgO	3.14	1.55	3.39	1.83	2.53	1.90
CaO	0.26	13.30	0.26	12.70	3.49	8.29
Na_2O	0.75	1.72	0.74	1.59	0.82	1.65
K_2O	5.03	0.75	4.92	1.02	2.46	0.79
P_2O_5	0.24	0.20	0.29	0.18	0.25	0.19
[6]LOI	4.52	12.08	4.73	11.44	5.72	8.67
Subtotal	99.55	99.99	99.54	100.58	99.75	99.48
			[7]Trace Elements			
Ba	754	95	758	144	370	110
Sr	24	371	25	362	126	224
V	128	42	140	59	80	45
Y	30	23	30	25	20	23
Zn	50	33	63	64	44	31
[8]Rb					118	29
[8]Zr					117	291
[9]Org C					0.140	0.079
[9]Carb C					0.811	1.957
[9]Total C					0.951	2.036
[9]Total S					0.056	0.051

FOOTNOTES TO APPENDIX 2

1) Distance from contact with overlying Shawangunk Formation.

2) Specific gravities determined by water immersion.

3) Rock Type: ms, mudstone; sl, slate; ss, sandstone; qt, quartzite

4) Solutions for major element analyses were prepared by fusing 100 mg of powdered sample with 600 mg of lithium metaborate/tetraborate flux at 1100 degrees C for 30 minutes. The beads were dissolved in 40 ml of 4% nitric acid, then filtered and diluted to 500 ml. Solutions were analyzed using a Jarrell-Ash 975 Plasma Atomcomp and compared against the USGS standards GSP-1 and BCR-1. Experimental error using this instrument was about 2 percent relative.

5) Ferrous iron content was determined by following the USGS method described by Shapiro (1975). 0.5 g powdered sample was boiled in sulfuric and hydrofluoric acids for 10 minutes, added to saturated boric acid, and then titrated against potassium dichromate. The indicator solution used was sodium diphenylamine sulfonate in sulfuric and phosphoric acids. Experimental error for these determinations was under 2 percent relative. Ferric iron content was calculated by subtracting ferrous iron from total iron by the major element procedure.

6) Weight percent of volatiles was determined by weight loss on ignition following heating the powdered sample for 2 hours at 1100 degrees C.

7) Barium, strontium, vanadium, yttrium, and zinc analyses were obtained for all samples using the major element procedure (see 4 above). For the 26 samples selected for additional analyses, a more accurate trace element procedure was followed to determine the same five elements. For these samples, only the trace element procedure results are reported. For all other samples, the barium, strontium, and zinc values from the major element procedure have been corrected for a systematic difference between the major and trace element procedures. These corrections had a correlation coefficient of 0.99 or higher. No reliable correction could be applied to the vanadium and yttrium values; they are reported as obtained from the major element procedure.

Solutions for trace element analyses were prepared by heating 1.000 g of sample powder in nitric, perchloric, and hydrofluoric acids until perchloric fumes appeared for at least 30 minutes. Then hydrochloric acid and water were added and the solution brought to boiling. Solutions were diluted to 100 ml and analyzed against USGS GSP-1 on the same instrument used for major elements.

8) Pellets for X-ray fluorescence studies were prepared by mixing 750 mg of sample powder with 250 mg of boric acid. A backing of pure boric acid gave stability to the pellets. This mixture was pressed for 10 seconds at 2000 psi in a hydraulic press. The pellets were then analyzed in a General Electric X-Ray fluorescence unit. Three counts of 100 seconds each were taken on the K-alpha peaks of Rb and Zr. Background counts were taken at 30 degrees. The standards used for calibration curves were USGS G-2, GSP-1, BCR-1, and AGV-1. Experimental error on this instrument was about 5 percent relative.

9) Total carbon and total sulfur were determined by fusing 0.25 g powdered sample in a Leco CS-244 Carbon/Sulfur Determinator with HF-100 Induction Furnace. A Leco calibration standard was used (0.352% C and 0.0137% S). A Lecocel accelerator was added to each sample to ensure complete fusion. Nonvolatile organic carbon was determined by reacting about 0.33 g sample powder with an excess of hydrochloric acid, then filtering, drying, and fusing in the Leco as before. Carbonate carbon content was obtained by difference from total carbon. Reproducibility for the standards was ±0.03 wt. % C and -0.005 wt. % S. For the samples, reproducibility was ±0.012 wt. % C and ±0.041 wt. % S.

Reference Cited

Shapiro, L., 1975. Rapid Analysis of Silicate, Carbonate, and Phosphate Rocks, Revised Edition. USGS Bulletin 1401. 76 p.

APPENDIX 3. AVERAGE GAIN OR LOSS OF SELECTED ELEMENTS RELATIVE TO PARENT COMPOSITION

Sample	Distance	del Ti	Δ% Ti	del Fe	Δ% Fe	del Mg	Δ% Mg	del Mn	Δ% Mn
					Mudstone, Slates				
3B	3.0	-0.01	-1.18	-2.21	-41.83	-0.76	-30.41	-0.01	-27.87
3C	3.0	0.02	1.92	-2.32	-45.99	-0.60	-22.89	-0.01	-24.65
3D	3.0	0.02	1.76	5.36	53.30	0.66	21.72	0.01	23.37
4A	4.0	0.02	2.02	-0.57	-8.64	0.48	13.28	0.01	17.45
4B	4.0	0.09	7.51	-0.76	-11.63	0.45	12.37	0.01	13.64
4C	4.0	0.02	1.39	-0.67	-10.32	0.45	12.74	0.01	17.77
6.5-1	6.5	0.03	2.75	-1.85	-32.95	-0.45	-16.76	-0.00	-11.64
6.5-2	6.5	0.04	3.60	-1.61	-28.29	-0.47	-17.64	-0.01	-16.01
6.6-1	6.6	0.05	4.56	-0.18	-2.61	-0.17	-6.03	-0.00	-14.14
6.6-2	6.6	0.08	6.80	-0.31	-4.56	-0.33	-12.08	0.00	0.37
24	7.3	-0.00	-0.28	-0.35	-4.84	-0.19	-6.07	0.01	11.22
30	9.1	-0.09	-8.54	-0.93	-14.21	-0.41	-14.41	-0.00	-3.58
34	10.4	-0.05	-4.26	-0.71	-10.65	-0.32	-11.01	0.00	3.77
45	13.7	-0.07	-6.39	-0.06	-0.80	-0.26	-8.68	0.00	4.34
51	15.5	-0.01	-0.52	-1.31	-21.57	-0.58	-22.07	-0.00	-8.47
70	21.3	-0.08	-7.51	0.32	4.04	-0.44	-15.39	0.02	35.46
83A	25.3	-0.02	-1.57	1.26	14.24	-0.85	-35.59	0.00	1.26
92	28.0	-0.12	-11.81	0.01	0.14	-0.67	-26.60	-0.01	-20.23
123A	37.5	0.08	7.32	-0.03	-0.46	-0.35	-13.06	0.00	4.54
123B	37.5	0.14	12.91	0.08	1.28	-0.46	-19.53	0.00	8.59
39.5-1	39.5	0.07	5.59	0.10	1.28	0.36	10.26	0.00	5.20
39.5-2	39.5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
136	41.5	0.06	5.12	0.23	3.10	-0.06	-1.93	0.01	18.78
139A	42.4	0.01	1.10	-2.04	-37.87	-0.67	-26.06	-0.00	-9.42
139B	42.4	0.11	9.77	2.21	24.29	-0.74	-31.90	-0.00	-3.41
155	47.2	-0.01	-0.66	-0.65	-9.66	-0.32	-10.87	-0.00	-5.89
168A	51.2	-0.10	-8.84	0.23	2.61	-0.04	-1.08	0.01	12.02
203A-1	61.9	0.07	5.86	0.09	1.24	-0.53	-21.05	-0.00	-0.25
67.4	67.4	-0.03	-3.07	-0.07	-0.95	0.31	8.77	-0.00	-4.15
349A	75.9	-0.01	-0.87	2.05	23.06	-0.23	-8.15	0.00	11.11
349C	75.9	0.01	0.83	-0.98	-15.02	-0.89	-37.85	-0.01	-15.58
356	78.0	0.13	10.75	0.41	5.35	-0.40	-14.51	0.00	3.33
389	88.1	-0.10	-10.84	-0.21	-3.04	-0.62	-24.89	0.00	10.15
90.1-1A	90.1	-0.07	-7.98	1.22	16.40	-0.07	-2.78	-0.00	-8.83
422A	98.1	0.42	25.45	-4.34	-137.89	-2.07	-179.22	-0.02	-109.22
422B	98.1	0.38	23.24	-1.30	-19.39	-1.66	-100.06	-0.01	-49.84
453A-1	107.6	0.05	4.20	-0.48	-7.18	-0.71	-29.21	-0.01	-17.95
453C	107.6	0.02	1.53	0.02	0.22	-0.20	-7.10	-0.00	-3.70
113.8-A1	113.8	0.02	2.85	0.89	14.24	0.23	8.88	-0.00	-3.67
113.8-A2	113.8	0.03	3.74	0.99	15.78	0.33	12.62	0.00	1.45
113.8-A3	113.8	0.19	17.24	0.08	1.21	-0.07	-2.51	-0.00	-9.59
117.5-2	117.5	-0.01	-0.90	0.31	4.77	-0.18	-7.00	-0.01	-21.62
117.8-B	117.8	-0.01	-1.93	2.79	38.96	0.16	6.81	0.00	10.20
492A	119.5	-0.09	-10.19	-0.59	-9.39	-0.58	-23.97	-0.01	-51.35
512A	125.6	-0.04	-4.63	-0.65	-11.12	-0.54	-23.69	-0.01	-20.84
513A	125.9	0.05	5.35	-0.37	-6.59	-0.22	-9.39	0.00	0.19
513B	125.9	0.22	16.13	-1.23	-19.89	-0.28	-9.49	0.02	36.14
514A	126.2	-0.23	-36.10	2.13	30.09	0.53	19.18	0.01	20.44
516A	126.8	0.07	5.93	-0.52	-7.83	-0.41	-15.10	0.00	0.70
127.8-1	127.8	-0.02	-2.38	-0.40	-6.51	-0.55	-23.61	-0.00	-11.63

APPENDIX 3, continued

Sample	Distance	del Ti	Δ% Ti	del Fe	Δ% Fe	del Mg	Δ% Mg	del Mn	Δ% Mn
				Graywacke, Metagraywacke					
3A	3.0	-0.13	-11.50	-1.59	-31.09	0.05	1.89	-0.01	-34.28
83B	25.3	0.02	2.52	-0.33	-6.82	-0.06	-3.88	-0.01	-21.41
45	45.0	-0.08	-9.47	1.50	22.81	0.66	27.99	0.31	84.41
168B	51.2	-0.08	-10.26	0.30	5.48	0.18	9.32	-0.00	-7.03
203A-2	61.9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
320	67.1	-0.17	-25.06	-0.19	-4.15	0.10	6.00	-0.01	-19.97
3-1	67.3	-0.21	-25.89	-0.50	-8.81	0.57	19.59	-0.01	-16.24
67.3-2	67.3	-0.23	-33.77	-0.29	-5.55	0.49	20.50	0.00	11.28
349B	75.9	0.34	22.67	1.52	19.21	0.02	0.78	0.02	28.78
90.1-1B	90.1	-0.07	-5.70	1.32	14.46	0.13	5.09	-0.01	-20.21
90.1-2	90.1	-0.17	-13.53	-0.77	-10.63	0.18	5.53	-0.01	-36.52
453A-2	107.6	-0.16	-11.38	-1.29	-18.35	-0.37	-15.26	-0.01	-22.73
453B	107.6	-0.12	-15.35	-0.58	-13.04	-0.19	-12.59	-0.01	-19.50
113.8-B1	113.8	-0.07	-6.13	-0.47	-7.08	0.18	6.73	-0.00	-4.49
113.8-B2	113.8	-0.04	-4.87	0.28	4.89	0.41	17.89	0.03	39.95
113.8-B3	113.8	-0.08	-9.47	0.51	8.16	0.42	17.82	0.04	46.15
113.8-B4	113.8	-0.10	-7.44	-0.79	-11.70	0.08	2.95	-0.01	-17.61
475A	114.3	-0.24	-33.95	1.07	15.40	0.36	15.59	-0.00	-13.85
117.5-3	117.5	0.10	5.34	-1.53	-24.50	-0.16	-5.60	0.03	23.88
117.8-A1	117.8	-0.04	-4.54	1.02	14.32	0.12	5.93	0.22	69.25
117.8-A2	117.8	-0.12	-12.06	-0.55	-9.71	-0.02	-0.90	-0.01	-36.23
117.8-A3	117.8	-0.03	-2.99	0.10	1.94	0.15	7.88	0.00	3.79
117.8-A4	117.8	-0.10	-8.41	-0.55	-8.48	-0.24	-11.51	-0.01	-35.54
514B	126.2	-0.07	-6.91	-0.93	-17.77	0.07	2.98	0.01	11.87
515	126.5	-0.21	-16.93	-1.08	-15.07	-0.18	-6.39	-0.01	-29.87
127.8-2	127.8	0.26	14.44	-1.22	-21.40	-0.38	-19.50	-0.01	-25.45

Sample	del Zn	Δ% Zn	del V	Δ% V	del Y	Δ% Y
			Mudstone, Slates			
3B	-36.90	-160.80	9.64	5.97	-3.55	-15.77
3C	2.04	3.26	-8.09	-5.78	-3.69	-16.84
3D	61.73	64.17	12.26	9.81	4.31	18.44
4A	-44.27	-306.37	31.43	17.96	-9.93	-66.23
4B	-40.47	-219.33	31.39	17.74	-3.16	-14.36
4C	-16.66	-40.20	40.62	22.32	-2.64	-12.01
6.5-1	104.33	61.21	15.48	9.27	-8.73	-51.36
6.5-2	151.53	71.32	11.09	7.06	-8.17	-48.06
6.6-1	224.20	81.23	7.41	5.01	-1.52	-6.64
6.6-2	233.43	81.90	3.31	2.30	-2.14	-9.58
24	126.85	65.57	-5.67	-3.92	17.70	39.78
30	177.95	72.95	-4.59	-3.19	6.54	20.12
34	113.03	64.06	-2.17	-1.49	10.05	27.93
45	284.50	80.95	0.23	0.15	13.09	33.57
51	147.28	69.65	-13.74	-10.26	10.08	28.01
70	118.51	63.56	-15.97	-11.83	22.54	45.09
83A	534.26	86.45	1.53	1.00	2.35	8.24
92	232.18	78.32	0.93	0.63	17.20	40.01
123A	503.52	91.98	1.52	1.07	17.11	41.74
123B	416.90	99.16	-8.57	-7.14	25.91	57.58
39.5-1	8.35	12.30	15.73	9.71	0.20	0.77
39.5-2	0.00	0.00	0.00	0.00	0.00	0.00
136	280.21	82.06	-2.36	-1.65	12.73	33.49
139A	87.36	57.68	-8.27	-5.87	5.88	18.37
139B	221.23	82.11	-9.24	-7.10	16.57	41.42
155	-2.88	-5.00	1.64	1.09	20.74	44.12
168A	360.16	74.41	17.53	9.37	10.23	25.13
203A-1	815.80	96.04	7.02	4.77	26.48	52.96
67.4	104.66	62.32	22.08	12.91	-0.67	-2.68
349A	161.58	76.78	13.78	9.13	24.21	51.52
349C	19.60	24.06	1.93	1.27	8.68	24.80
356	96.36	61.59	-2.53	-1.77	15.66	38.19
389	851.19	95.06	0.99	0.69	21.75	47.27
90.1-1A	336.42	97.11	11.95	8.72	3.52	14.07
422A	126.61	62.85	-16.41	-11.81	0.77	2.74
422B	263.61	72.73	2.43	1.47	15.03	33.3
453A-1	270.10	82.49	5.32	3.57	24.21	49.42
453C	381.25	88.57	18.21	11.45	13.85	36.44
113.8-A1	10.31	19.48	22.04	17.29	6.97	28.45
113.8-A2	426.92	115.40	236.73	81.56	3.23	15.01
113.8-A3	-1.04	-2.08	2.38	1.87	6.11	22.62
117.5-2	944.78	110.31	6.24	4.86	7.81	27.89
117.8-B	853.51	131.02	18.11	15.62	1.61	8.46
492A	172.78	79.46	-6.96	-5.39	17.60	43.99
512A	84.51	66.83	14.32	10.23	11.26	35.20
513A	48.05	54.94	-3.85	-3.34	6.76	26.01
513B	29.49	32.60	-9.66	-7.00	13.06	33.49
514A	31.74	46.37	11.72	9.93	14.67	48.91
516A	47.05	45.04	-7.55	-5.59	9.45	27.79
127.8-1	377.12	97.08	-2.94	-2.34	5.30	19.62

APPENDIX 3, continued

Sample	del Zn	Δ% Zn	del V	Δ% V	del Y	Δ% Y
			Graywacke, Metagraywacke			
3A	-88.59	-82.45	34.74	20.38	-16.23	-108.17
83B	103.70	35.64	3.83	4.88	-2.29	-8.84
45	-78.75	-100.38	18.41	20.45	8.36	23.23
168B	34.31	16.58	0.78	1.06	-6.42	-31.03
203A-2	0.00	0.00	0.00	0.00	0.00	0.00
320	48.39	23.10	3.70	5.14	-1.15	-4.59
3-1	-41.69	-27.34	12.76	11.81	-7.00	-28.00
67.3-2	-31.57	-22.01	6.04	7.10	-10.79	-63.49
349B	-66.22	-59.96	12.94	12.81	34.42	44.70
90.1-1B	78.53	22.09	23.96	17.43	-6.24	-21.51
90.1-2	15.31	4.87	6.59	4.88	-7.50	-22.73
453A-2	-49.64	-22.93	3.20	2.21	-3.83	-8.52
453B	36.65	17.45	-13.26	-22.96	-6.19	-29.46
113.8-B1	-117.32	-215.47	11.15	9.18	-5.57	-17.97
113.8-B2	-80.45	-95.27	12.35	13.42	0.64	2.10
113.8-B3	-64.67	-61.01	8.60	9.56	5.13	13.93
113.8-B4	-113.43	-167.55	11.94	8.71	-6.41	-19.37
475A	-29.81	-19.95	18.83	18.28	-2.21	-7.89
117.5-3	249.56	30.42	2.94	2.11	-7.40	-20.57
117.8-A1	455.34	59.02	10.51	10.95	5.68	14.55
117.8-A2	300.91	47.17	3.78	3.90	-10.11	-48.14
117.8-A3	344.81	61.35	5.55	6.95	-4.07	-17.18
117.8-A4	525.74	48.77	9.13	7.73	-6.15	-20.51
514B	-97.46	-126.24	7.18	6.95	-7.66	-30.87
515	-73.41	-46.17	9.61	6.32	-8.12	-23.59
127.8-2	46.05	13.77	7.05	5.77	-7.28	-24.28