Grays River Volcanics - Sample Locations

	Lat 46°	Long 123°		
Sample #	**Lat (min)**	**Long (min)**	**Locality Name**	**Description**
GR08-01	26.561	43.000		Rosette
GR08-02				
GR08-03	23.750	28.667	Fossil Creek 2	
GR08-04			Fossil Creek 3	
GR08-10			Germany Ck Road	Crescent outcrop on road
GR08-11	21.958	27.951	LF 800 Road - small quarry	basalt column
GR08-12	21.955	24.669	SF800 Road - new quarry	basalt
GR08-13	22.430	25.435	SF903 - old borrow pit	basalt
GR08-14	22.117	25.187	SF900 - old borrow pit	basalt
GR08-15	22.504	18.905	Huckleberry Ridge	reddish fragmental material
GR08-16	22.504	18.905	Huckleberry Ridge	basalt - silicified (?)
GR08-17	22.494	18.980	500 Road - Pit w/ pillows	Crescent Basalt outcrop
GR08-18	22.494	18.980	500 Road - Pit w/ pillows	shale - thinly bedded
GR08-19	22.842	0.277	Pumphrey Mtn	basalt column
GR08-20	22.842	0.277	Pumphrey Mtn	sandstone
GR08-21	22.842	0.277	Pumphrey Mtn	coal like layer
GR08-40	27.855	44.442		Crescent Basalt
GR08-41	27.855	44.442		Crescent Basalt
GR08-42	28.907	41.829	Pillow Pit	fine-grained layer above pillows
GR08-43	24.638	22.608	500 Rd Pit - Big Pit	non-vesciular column
GR08-44	24.638	22.608	500 Rd Pit - Big Pit	non-vesciular column
GR08-45	24.638	22.608	500 Rd Pit - Big Pit	non-vesciular column
GR08-46	24.638	22.608	500 Rd Pit - Big Pit	non-vesciular column
GR08-47	24.874	24.532	500 Rd Pit - Smaller	basalt column
GR08-48	24.874	24.532	500 Rd Pit - Smaller	basalt column
GR08-49	24.352	28.296	Fossil Creek 3	
GR08-60	24.352	28.296	Fossil Creek 3	
GR08-61	24.352	28.296	Fossil Creek 3	
GR08-62	24.352	28.296	Fossil Creek 3	
GR08-81	24.352	28.296	Fossil Creek 3	
GR08-82*	24.352	28.296	Fossil Creek 3	
GR08-83	24.352	28.296	Fossil Creek 3	
GR08-84	24.352	28.296	Fossil Creek 3	
GR08-85	24.352	28.296	Fossil Creek 3	
GR08-86	24.352	28.296	Fossil Creek 3	
GR08-87	24.352	28.296	Fossil Creek 3	
GR08-88	24.352	28.296	Fossil Creek 3	
GR08-100	18.124	1.234	9000 Quarry 1	basalt by pond
GR08-101	18.124	1.234	9000 Quarry 1	columnar basalt w amygdules
GR08-102	18.116	1.640	9000 Quarry 2 - upper bench	columnar flow
GR08-103	18.116	1.640	9000 Quarry 2 - middle bench rt side	dike?
GR08-104	18.116	1.640	9000 Quarry 2 - lower bench - left side	basalt
GR08-105	18.116	1.604	9000 Quarry 2 - lower bench rt side	basalt
GR08-106	18.116	1.604	9000 Quarry 2 - middle bench	basalt
GR08-107	18.116	1.604	9000 Quarry 2 - lower bench way left	basalt
GR08-108	19.115	4.617	9213 Quarry - far rt side	fine grained basalt
GR08-120	18.783	4.126	2240 Quarry 1	basalt - slightly altered top of wall
GR08-121	18.783	4.126	2240 Quarry 1	basalt - float
GR08-122	18.783	4.126	2240 Quarry 1	basalt - middle of section

GR08-123	18.783	4.126	2240 Quarry 1	basalt - right side of pit
GR08-140	18.124	1.234	9000 Quarry 1	amygdaloidal basalt
GR08-141	18.124	1.234	9000 Quarry 1	amygdaloidal basalt
GR08-142	18.124	1.234	9000 Quarry 1	amygdaloidal basalt
GR08-143	18.116	1.647	9000 Quarry 2 - middle bench	edge of dike (?)
GR08-144	18.116	1.647	9000 Quarry 2 - middle bench	center of dike (?)
GR08-145	19.115	4.617	5321 Quarry (lunch)	float from edge of pit
GR08-146	20.030	4.453	9213 Quarry	columnar basalt
GR08-147	20.030	4.453	9213 Quarry	columnar basalt - rt side
GR08-148	20.030	4.453	9213 Quarry	columnar basalt
GR08-200	18.573	1.660	9300 Rd Quarry 1	massive basalt from columns
GR08-201	18.573	1.660	9300 Rd Quarry 1	massive basalt from columns
GR08-202	20.566	5.959	Abernathy Mtn summit	subcrop - not v. fresh
GR08-203	20.045	5.661	9300 Rd outcrop	basalt w olivine phenos
GR08-204	19.838	4.958	9326 Rd outcrop	columnar flow w vesicles
GR08-205	18.992	3.251	9300 Rd jct w 9318	columnar flow
GR08-206	18.226	2.582	9300 Rd Quarry 2	columnar flow
GR09-01	9.001	0.639	Terra Firma Quarry - east side	dike
GR09-02	9.001	0.639	Terra Firma Quarry	volcaniclastic
GR09-03	9.112	0.829	Terra Firma Quarry - west side	sill, amygdaloidal
GR09-04	9.206	55.440	S. portion of Columbia Heights Rd	columnar flow
GR09-05	9.345	54.939	Between railroad and Cowlitz River	columnar flow, amygdule-rich
GR09-06	10.530	54.525	Rocky Point	columnar flow
GR09-07	19.573	59.337	Quarry - Bebe Mtn	middle flow
GR09-08	19.573	59.337	Quarry - Bebe Mtn	upper flow
GR09-09	19.573	59.337	Quarry - Bebe Mtn	ashey-clay interbed layer
GR09-10	19.550	59.329	Quarry - Bebe Mtn	lower flow, amygdaloidal
GR09-11	21.938	56.211	Along Hwy 411	columnar flow, amygdaloidal
GR09-12	7.184	13.827	Along Hwy 30	massive flow, youngest
GR09-13	7.184	13.827	Along Hwy 30	massive flow, intermediate
GR09-14	7.184	13.827	Along Hwy 30	massive flow, older
GR09-15	7.184	13.827	Along Hwy 30	massive flow, oldest
GR09-15b	15.971	7.877	Germany Creek	massive flow 2
GR09-16	15.958	7.865	Germany Creek	massive flow 1
GR09-17	15.996	7.873	Germany Creek	massive flow 3
GR09-18	15.994	7.859	Germany Creek	massive flow 4
GR09-19	15.995	7.855	Germany Creek	massive flow 5
GR09-20	16.011	7.827	Germany Creek	massive flow 6
GR09-21	16.021	7.815	Germany Creek	massive flow 7
GR09-22	16.027	7.807	Germany Creek	massive flow 8
GR09-23	16.304	7.456	Germany Creek	massive flow 10
GR09-24	16.137	7.685	Germany Creek	massive flow 9
GR09-25	6.458	13.936	Palm Hill Rd	thick pumice layer ($\leq$ 4 m thick)
GR09-26	7.184	13.827	Along Hwy 30	thin interbedded baked palesol

Appendix II.

GRV Geochemistry

Sample	GR08-1	GR08-02	GR08-04	GR08-11	GR08-12	GR08-13	GR08-14
Element							
SiO2 (wt %)	50.23	48.41	48.78	50.80	48.77	48.33	48.95
TiO2 (wt%)	3.44	2.68	3.00	2.82	3.04	2.73	3.68
Al2O3 (wt%)	14.70	19.72	14.58	13.45	15.15	19.66	14.84
$Fe2O3_T$ (wt%)	13.90	10.99	13.86	15.73	13.55	10.83	14.51
MgO (wt%)	3.68	3.56	5.09	4.56	4.49	3.56	3.53
MnO (wt%)	0.27	0.14	0.18	0.22	0.18	0.14	0.28
CaO (wt%)	8.34	11.15	10.64	8.17	10.39	11.30	8.56
Na2O (wt%)	3.63	2.84	2.89	2.85	3.09	2.84	3.66
K2O (wt%)	1.15	0.20	0.56	0.89	0.89	0.31	1.37
P2O5 (wt%)	0.64	0.31	0.40	0.51	0.44	0.30	0.62
LOI							
ORIG TOTAL							
Mg#	0.34	0.39	0.42	0.37	0.40	0.39	0.32
Zr (ppm)	342	161	223	183	231	177	337
Sr (ppm)	513	464	446	289	427	533	566
Y (ppm)	47	29	33	42	38	30	41
Sc (ppm)	23	22		37	29	21	
Cr (ppm)	8	17		48	59	16	
Ba (ppm)	232		166		113		
Th (ppm)	3.39		2.5		2.09		
Nb (ppm)	36.95		31.11		24.47		
Hf (ppm)	6.06		5.55		4.58		
Ta (ppm)	2.44		2.04		1.61		
U (ppm)	0.97		0.73		1.49		
Pb (ppm)	2.7		1.82		1.97		
Rb (ppm)	17.7		10.1		1.9		
Cs (ppm)	0.18		0.11		0.12		
La (ppm)	30.42		25.79		20.29		
Ce (ppm)	66.23		57.49		45.15		
Pr (ppm)	8.58		7.67		6.04		
Nd (ppm)	36.34		32.84		26.16		
Sm (ppm)	8.46		7.93		6.35		
Eu (ppm)	2.77		2.67		2.3		
Gd (ppm)	8.39		7.93		6.55		
Tb (ppm)	1.31		1.23		1.03		
Dy (ppm)	7.49		7.12		5.83		
Ho (ppm)	1.44		1.35		1.12		
Er (ppm)	3.62		3.32		2.82		
Tm (ppm)	0.49		0.44		0.38		
Yb (ppm)	2.84		2.59		2.22		
Lu (ppm)	0.43		0.39		0.33		
B (ppm)			11.44				
Be (ppm)			7.25				

Appendix II.

GRV Geochemistry

Sample	GR08-16	GR08-19	GR08-43	GR08-44	GR08-47	GR08-48	GR08-61
Element							
SiO2 (wt %)	47.54	48.35	48.54	47.96	48.49	48.77	48.52
TiO2 (wt%)	3.40	2.94	3.69	3.56	3.10	2.54	3.72
Al2O3 (wt%)	15.01	14.86	15.69	15.88	16.36	17.82	14.23
$Fe2O3_T$ (wt%)	14.35	13.54	13.49	13.35	12.74	11.48	14.64
MgO (wt%)	5.27	5.56	3.72	4.12	3.91	4.31	4.69
MnO (wt%)	0.18	0.18	0.20	0.22	0.19	0.14	0.20
CaO (wt%)	10.25	10.90	10.14	10.42	10.80	11.49	9.52
Na2O (wt%)	2.93	2.73	3.26	3.25	3.00	2.88	3.21
K2O (wt%)	0.72	0.55	0.91	0.84	0.98	0.56	0.54
P2O5 (wt%)	0.35	0.39	0.37	0.39	0.42		0.73
LOI							
ORIG TOTAL							
Mg#	0.42	0.45	0.35	0.38	0.38	0.43	0.39
Zr (ppm)	231	197	253	222	228		227
Sr (ppm)	447	364	429	392	466		419
Y (ppm)	34	32	36	35	33		40
Sc (ppm)	29	30		27			
Cr (ppm)	61	49		27			
Ba (ppm)		182					
Th (ppm)		2.93					
Nb (ppm)		34.71					
Hf (ppm)		5.65					
Ta (ppm)		2.28					
U (ppm)		0.83					
Pb (ppm)		3.04					
Rb (ppm)		9.3					
Cs (ppm)		0.21					
La (ppm)		28.01					
Ce (ppm)		61.27					
Pr (ppm)		8.01					
Nd (ppm)		34.05					
Sm (ppm)		7.97					
Eu (ppm)		2.64					
Gd (ppm)		7.94					
Tb (ppm)		1.24					
Dy (ppm)		7.05					
Ho (ppm)		1.34					
Er (ppm)		3.31					
Tm (ppm)		0.44					
Yb (ppm)		2.55					
Lu (ppm)		0.38					
B (ppm)							
Be (ppm)							

Appendix II.

GRV Geochemistry

Sample	GR08-82	GR08-100	GR08-102	GR08-104	GR08-108	GR08-121	GR08-122
Element							
SiO2 (wt %)	49.14	48.41	48.02	48.58	48.91	49.67	49.77
TiO2 (wt%)	3.14	3.02	2.81	2.80	3.73	3.28	3.44
Al2O3 (wt%)	15.07	14.33	15.28	15.88	14.22	14.45	14.83
$Fe2O3_T$ (wt%)	12.99	13.05	12.77	11.52	13.75	14.28	13.90
MgO (wt%)	4.76	5.44	5.68	5.16	4.55	4.19	3.91
MnO (wt%)	0.18	0.17	0.17	0.15	0.19	0.28	0.16
CaO (wt%)	11.09	11.32	11.61	12.25	9.54	8.67	8.74
Na2O (wt%)	2.83	2.78	2.62	2.59	3.48	3.44	3.49
K2O (wt%)	0.37	1.05	0.71	0.69	0.93	1.01	0.74
P2O5 (wt%)	0.42	0.44	0.33	0.38	0.71	0.74	1.01
LOI							
ORIG TOTAL							
Mg#	0.42	0.45	0.47	0.47	0.40	0.37	0.36
Zr (ppm)	231	226	179	205	262	299	314
Sr (ppm)	566	423	365	431	427	417	417
Y (ppm)	41	31	30	31	41	52	49
Sc (ppm)			31			27	
Cr (ppm)			62			37	
Ba (ppm)							
Th (ppm)							
Nb (ppm)							
Hf (ppm)							
Ta (ppm)							
U (ppm)							
Pb (ppm)							
Rb (ppm)							
Cs (ppm)							
La (ppm)							
Ce (ppm)							
Pr (ppm)							
Nd (ppm)							
Sm (ppm)							
Eu (ppm)							
Gd (ppm)							
Tb (ppm)							
Dy (ppm)							
Ho (ppm)							
Er (ppm)							
Tm (ppm)							
Yb (ppm)							
Lu (ppm)							
B (ppm)							
Be (ppm)							

Appendix II.

GRV Geochemistry

Sample	GR08-140	GR08-143	GR08-144	GR08-145	GR08-146	GR08-148	GR08-200
Element							
SiO2 (wt %)	48.07	48.94	48.49	50.03	48.35	48.79	47.49
TiO2 (wt%)	3.00	3.27	3.18	3.35	3.77	3.85	3.73
Al2O3 (wt%)	13.71	15.66	14.73	14.62	14.37	14.41	13.98
$Fe2O3_T$ (wt%)	14.16	12.93	14.11	13.67	14.64	14.12	15.46
MgO (wt%)	6.55	4.77	4.85	4.38	4.61	4.56	4.74
MnO (wt%)	0.18	0.13	0.18	0.20	0.20	0.19	0.23
CaO (wt%)	10.61	10.29	10.69	8.57	9.31	9.25	9.83
Na2O (wt%)	2.59	2.91	2.83	3.42	3.28	3.31	3.15
K2O (wt%)	0.74	0.65	0.59	1.12	0.85	0.78	0.74
P2O5 (wt%)	0.38	0.45	0.34	0.62	0.62	0.75	0.67
LOI							
ORIG TOTAL							
Mg#	0.48	0.42	0.41	0.39	0.38	0.39	0.38
Zr (ppm)	201	232	211	350	240	282	237
Sr (ppm)	353	446	407	454	388	462	433
Y (ppm)	30	33	35	47	41	44	44
Sc (ppm)	29		31	23	25	25	32
Cr (ppm)	140		45	18	22		17
Ba (ppm)						273	
Th (ppm)						4.26	
Nb (ppm)						46.05	
Hf (ppm)						7.36	
Ta (ppm)						4.55	
U (ppm)						1.17	
Pb (ppm)						2.53	
Rb (ppm)						12.94	
Cs (ppm)						0.23	
La (ppm)						40.67	
Ce (ppm)						89.56	
Pr (ppm)						11.79	
Nd (ppm)						50.07	
Sm (ppm)						11.64	
Eu (ppm)						3.70	
Gd (ppm)						11.46	
Tb (ppm)						1.76	
Dy (ppm)						9.91	
Ho (ppm)						1.87	
Er (ppm)						4.60	
Tm (ppm)						0.62	
Yb (ppm)						3.61	
Lu (ppm)						0.54	
B (ppm)							
Be (ppm)							

Appendix II.

GRV Geochemistry

Sample	GR08-201	GR08-202	GR08-203	GR08-204	GR08-205	GR08-206	GR09-01
Element							
SiO2 (wt %)	48.19	49.53	48.07	48.45	47.83	51.19	46.86
TiO2 (wt%)	3.11	3.05	3.20	3.20	3.08	3.28	3.18
Al2O3 (wt%)	14.95	17.09	14.72	14.11	14.27	14.58	15.14
$Fe2O3_T$ (wt%)	13.51	12.69	13.57	12.79	14.84	12.83	13.45
MgO (wt%)	5.13	3.77	5.85	6.08	6.05	4.08	5.66
MnO (wt%)	0.17	0.15	0.17	0.15	0.20	0.17	0.17
CaO (wt%)	11.23	9.22	9.95	11.46	9.96	8.71	11.79
Na2O (wt%)	2.85	3.22	3.08	2.68	2.82	3.53	2.85
K2O (wt%)	0.44	0.83	0.73	0.71	0.56	1.05	0.50
P2O5 (wt%)	0.42	0.44	0.66	0.36	0.39	0.56	0.41
LOI							1.63
ORIG TOTAL							94.21
Mg#	0.43	0.37	0.46	0.49	0.45	0.39	0.45
Zr (ppm)	199	266	238	238	214	357	223
Sr (ppm)	407	438	384	421	375	481	445
Y (ppm)	30	39	37	35	35	44	32
Sc (ppm)				32	27		29
Cr (ppm)				188	46		
Ba (ppm)							196
Th (ppm)							2.87
Nb (ppm)							35.55
Hf (ppm)							5.86
Ta (ppm)							4.39
U (ppm)							0.82
Pb (ppm)							1.87
Rb (ppm)							5.41
Cs (ppm)							0.02
La (ppm)							29.21
Ce (ppm)							65.33
Pr (ppm)							8.60
Nd (ppm)							37.07
Sm (ppm)							8.62
Eu (ppm)							2.86
Gd (ppm)							8.41
Tb (ppm)							1.33
Dy (ppm)							7.53
Ho (ppm)							1.41
Er (ppm)							3.43
Tm (ppm)							0.46
Yb (ppm)							2.66
Lu (ppm)							0.40
B (ppm)							6.72
Be (ppm)							7.57

Appendix II.

GRV Geochemistry

Sample	GR09-03	GR09-04	GR09-07	GR09-10	GR09-11	GR09-12	GR09-13
Element							
SiO2 (wt %)	47.01	45.93	47.83	46.96	47.85	48.99	47.71
TiO2 (wt%)	3.15	3.24	3.62	2.83	3.75	3.89	3.70
Al2O3 (wt%)	14.36	15.43	15.31	11.69	14.30	14.69	14.63
$Fe2O3_T$ (wt%)	14.31	15.73	13.50	13.33	13.75	13.68	14.84
MgO (wt%)	6.02	5.77	4.62	9.53	5.29	3.88	4.49
MnO (wt%)	0.21	0.21	0.17	0.15	0.16	0.14	0.17
CaO (wt%)	11.73	10.15	10.82	12.24	10.45	9.76	9.78
Na2O (wt%)	2.55	2.72	3.00	2.08	2.99	3.30	3.43
K2O (wt%)	0.27	0.56	0.71	0.82	0.89	1.20	0.72
P2O5 (wt%)	0.40	0.24	0.43	0.37	0.57	0.49	0.53
LOI	3.76	3.54	3.09	3.20	2.04	2.61	2.36
ORIG TOTAL	100.57	97.28	100.03	101.26	96.64	99.47	102.07
Mg#	0.45	0.42	0.40	**0.59**	0.43	0.36	0.37
Zr (ppm)	212	165	272	208	251	303	
Sr (ppm)	422	365	537	366	480	505	
Y (ppm)	31	38	33	27	38	39	
Sc (ppm)	29	32	25	38	29	27	
Cr (ppm)							
Ba (ppm)	156	66	266	176	211	272	
Th (ppm)	2.74	0.55	3.77	2.82	3.15	3.85	
Nb (ppm)	33.85	11.60	44.55	34.15	39.75	45.94	
Hf (ppm)	5.62	4.81	6.83	5.37	6.31	7.52	
Ta (ppm)	3.83	0.75	4.39	3.53	6.47	4.41	
U (ppm)	0.79	0.18	1.08	0.78	0.89	0.98	
Pb (ppm)	1.77	10.35	2.30	1.56	1.66	2.09	
Rb (ppm)	2.19	1.59	20.28	9.47	5.12	11.45	
Cs (ppm)	0.01	0.04	0.33	0.26	0.05	0.24	
La (ppm)	28.07	9.73	36.36	27.94	34.13	37.73	
Ce (ppm)	62.64	27.10	79.05	60.61	76.88	84.06	
Pr (ppm)	8.22	4.46	10.16	7.88	10.20	10.95	
Nd (ppm)	35.24	23.09	42.60	33.39	44.17	46.18	
Sm (ppm)	8.22	7.09	9.64	7.62	10.34	10.60	
Eu (ppm)	2.78	2.51	3.07	2.50	3.55	3.46	
Gd (ppm)	8.10	8.09	9.00	7.28	10.07	10.17	
Tb (ppm)	1.26	1.37	1.38	1.11	1.53	1.57	
Dy (ppm)	7.19	8.36	7.74	6.18	8.55	8.90	
Ho (ppm)	1.35	1.64	1.41	1.13	1.57	1.64	
Er (ppm)	3.26	4.12	3.33	2.71	3.89	3.95	
Tm (ppm)	0.43	0.58	0.45	0.37	0.50	0.53	
Yb (ppm)	2.55	3.44	2.54	2.04	2.92	3.01	
Lu (ppm)	0.37	0.52	0.37	0.30	0.42	0.45	
B (ppm)				6.91	5.57		
Be (ppm)				6.57	7.50		

Appendix II.

GRV Geochemistry

Sample	GR09-14	GR09-15	GR09-15b	GR09-16	GR09-17	GR09-18	GR09-19
Element							
SiO2 (wt %)	48.61	48.66	48.22	48.00	47.76	47.20	47.53
TiO2 (wt%)	3.72	3.36	3.60	3.46	2.72	2.75	3.00
Al2O3 (wt%)	14.92	15.10	14.19	14.63	15.14	14.82	15.85
$Fe2O3_T$ (wt%)	13.92	13.30	14.82	14.12	13.32	13.53	13.28
MgO (wt%)	4.04	4.22	4.73	4.93	5.53	5.77	5.02
MnO (wt%)	0.18	0.21	0.20	0.17	0.22	0.13	0.17
CaO (wt%)	9.76	9.29	9.84	10.34	11.91	11.68	11.10
Na2O (wt%)	3.39	3.59	3.23	2.92	2.65	2.66	2.80
K2O (wt%)	0.96	1.76	0.71	0.79	0.44	1.11	0.89
P2O5 (wt%)	0.50	0.51	0.47	0.63	0.31	0.36	0.35
LOI	2.25	2.20	2.13	3.40	2.97	2.97	3.25
ORIG TOTAL	99.47	82.17	96.77	100.92	103.48	106.13	95.21
Mg#	0.37	0.39	0.39	0.41	0.45	0.46	0.43
Zr (ppm)	308			278	195		201
Sr (ppm)	478			439	469		443
Y (ppm)	39			43	29		28
Sc (ppm)	29			27	34		33
Cr (ppm)							
Ba (ppm)	257			190	198		196
Th (ppm)	3.85			3.38	2.73		2.82
Nb (ppm)	45.76			41.82	32.63		34.43
Hf (ppm)	7.64			6.93	4.99		5.06
Ta (ppm)	3.00			5.48	3.24		5.81
U (ppm)	1.14			1.00	0.71		0.72
Pb (ppm)	1.98			2.03	1.63		1.45
Rb (ppm)	12.04			17.12	9.78		11.33
Cs (ppm)	0.17			0.19	0.21		0.11
La (ppm)	37.57			35.94	26.53		27.18
Ce (ppm)	82.87			80.58	58.03		58.55
Pr (ppm)	10.86			10.68	7.47		7.61
Nd (ppm)	45.38			46.16	31.08		31.73
Sm (ppm)	10.43			10.72	7.30		7.30
Eu (ppm)	3.40			3.45	2.43		2.48
Gd (ppm)	9.99			10.73	7.10		7.21
Tb (ppm)	1.57			1.65	1.11		1.12
Dy (ppm)	8.88			9.41	6.32		6.36
Ho (ppm)	1.68			1.78	1.19		1.16
Er (ppm)	4.09			4.30	2.86		2.87
Tm (ppm)	0.55			0.58	0.39		0.38
Yb (ppm)	3.18			3.34	2.23		2.17
Lu (ppm)	0.47			0.52	0.33		0.32
B (ppm)	49.48						6.07
Be (ppm)	8.20						6.78

Appendix II.

GRV Geochemistry

Sample	GR09-20	GR09-21	GR09-22	GR09-23	GR09-24
Element					
SiO2 (wt %)	53.48	57.13	45.66	47.83	48.79
TiO2 (wt%)	2.11	2.47	3.11	3.32	3.65
Al2O3 (wt%)	14.61	16.32	15.40	15.17	14.69
$Fe2O3_T$ (wt%)	11.29	9.24	14.30	13.71	13.42
MgO (wt%)	4.07	2.74	6.00	4.93	4.54
MnO (wt%)	0.16	0.08	0.19	0.17	0.20
CaO (wt%)	8.35	5.85	11.20	10.55	9.27
Na2O (wt%)	3.94	3.98	2.98	2.89	3.54
K2O (wt%)	1.69	1.91	0.73	1.03	1.21
P2O5 (wt%)	0.30	0.28	0.43	0.38	0.68
LOI	1.50	4.14	7.90	2.27	1.63
ORIG TOTAL	101.75	101.75	97.94	97.50	91.62
Mg#	0.42	0.37	0.45	0.42	0.40
Zr (ppm)	447		248	262	
Sr (ppm)	372		496	487	
Y (ppm)	46		33	36	
Sc (ppm)	25		28	32	
Cr (ppm)					
Ba (ppm)	401		254	263	
Th (ppm)	6.73		3.37	3.89	
Nb (ppm)	64.48		39.45	42.79	
Hf (ppm)	10.71		6.08	6.47	
Ta (ppm)	5.54		2.53	3.36	
U (ppm)	1.90		0.92	1.01	
Pb (ppm)	3.33		2.16	2.69	
Rb (ppm)	38.75		8.71	16.09	
Cs (ppm)	0.26		0.07	0.16	
La (ppm)	52.38		31.56	34.87	
Ce (ppm)	107.32		68.75	75.68	
Pr (ppm)	13.07		8.90	9.70	
Nd (ppm)	51.11		36.94	40.15	
Sm (ppm)	10.96		8.20	9.14	
Eu (ppm)	2.94		2.69	2.93	
Gd (ppm)	10.12		7.96	8.68	
Tb (ppm)	1.63		1.25	1.35	
Dy (ppm)	9.47		7.06	7.64	
Ho (ppm)	1.82		1.34	1.46	
Er (ppm)	4.72		3.32	3.56	
Tm (ppm)	0.65		0.46	0.49	
Yb (ppm)	3.94		2.67	2.89	
Lu (ppm)	0.60		0.40	0.42	
B (ppm)			15.85		
Be (ppm)			6.53		

Appendix II.
GRV Geochemistry

Sample	GR09-06 (RP)	GR08-17 (CB)
Element		
SiO2 (wt %)	47.63	48.58
TiO2 (wt%)	1.61	1.84
Al2O3 (wt%)	16.01	14.67
$Fe2O3_T$ (wt%)	12.22	12.62
MgO (wt%)	8.45	7.88
MnO (wt%)	0.16	0.24
CaO (wt%)	10.31	11.46
Na2O (wt%)	2.69	2.24
K2O (wt%)	0.62	0.29
P2O5 (wt%)	0.29	0.18
LOI	1.03	
ORIG TOTAL	93.19	
Mg#	**0.58**	**0.55**
Zr (ppm)	143	118
Sr (ppm)	368	198
Y (ppm)	23	30
Sc (ppm)	27	47
Cr (ppm)		300
Ba (ppm)	98	
Th (ppm)	1.36	
Nb (ppm)	11.82	
Hf (ppm)	3.50	
Ta (ppm)	0.75	
U (ppm)	0.39	
Pb (ppm)	1.30	
Rb (ppm)	2.92	
Cs (ppm)	0.03	
La (ppm)	14.37	
Ce (ppm)	32.65	
Pr (ppm)	4.41	
Nd (ppm)	19.20	
Sm (ppm)	4.67	
Eu (ppm)	1.67	
Gd (ppm)	4.99	
Tb (ppm)	0.80	
Dy (ppm)	4.87	
Ho (ppm)	0.96	
Er (ppm)	2.41	
Tm (ppm)	0.34	
Yb (ppm)	2.09	
Lu (ppm)	0.32	
B (ppm)	23.98	
Be (ppm)	4.18	

Appendix II.
GRV Geochemistry

ANALYTICAL ERROR

Error propagation was used to determine the standard error associated with the major oxide measurements. With the exception of SiO_2 (12%) and Fe_2O_3 (7%), all of the other major oxides have a standard error $\leq$ 6%. Based on BHVO-1, the accuracy of each major element was calculated. With the exception of K (17% deviation from the USGS accepted value), all of the rest of the major elements are less than $\leq$ 4%. Reported precision for trace elements and REE are 10% and 5%, respecitively. The precision related to B and Be analyses are 13% and 27%, respectively.

Summary of Age Determinations for Grays River Volcanics

Reference	Method	Age ± Std. Dev.	Sample ID	Sample Description / Location
Phillips et al. 1987	whole rock K/Ar	37.3 ± 2.2 Ma	K-Ar 1 (BP0604851)	GRV basalt Cowlitz River
Walsh 1987	zircon fission track	41 Ma		GRV inclusion in Ordway Cr. Stock
Moothart 1993	$^{40}Ar/^{39}Ar$	41.4 ± 0.7 Ma	SM91-139	Trachybasalt dike in NW exposures (S 1/2 of Sec 27,T12N, R7W)
Irving et al. 1996	whole rock 40Ar/39Ar	40.3 ± 0.3 Ma		Inclusion of GRV in tuff from the Cowlitz Formation
Irving et al. 1996	mean 40Ar/39Ar	38.9 ± 0.1 Ma		K-rich Oligoclase from tuff in Cowlitz Formation
Payne 1998	$^{40}Ar/^{39}Ar$	38.64 ± 0.40 Ma	CP-94-196	Lower section in S Abernathy Mtn (S 1/2 of Sec 35, T 10 N, R3W)
Payne 1998	$^{40}Ar/^{39}Ar$	37.44 ± 0.45 Ma	CP-94-68	NW Bebe Mtn (NW 1/4 of Sec 1, T10N, R3W)
Payne 1998	$^{40}Ar/^{39}Ar$	36.85 ± 0.46 Ma	CP-94-138	Upper section in Lower Olequa Creek (SE 1/4 of Sec 32, T11N, R2W)
Kleibacker 2001	$^{40}Ar/^{39}Ar$	40.01 ± 0.34 Ma	GC-1	Subaerial lava flow, Germany Creek (NE 1/2 of Sec 12, T9N, R4W)
Kleibacker 2001	$^{40}Ar/^{39}Ar$	39.35 ± 0.36	GC-2	subaerial lava flows, Germany Creek (S 1/2 of Sec 6, T9N, R3W)
Kleibacker 2001	$^{40}Ar/^{39}Ar$	39.98 ± 0.29 Ma	914L	GRV dike in Germany Creek (SW 1/4 of Sec 25, T10N, R4W)
Kleibacker 2001	$^{40}Ar/^{39}Ar$	39.56 ± 0.41 Ma	G810D	GRV dike in Germany Creek (NE 1/4 of Sec 12, T9N, R4W)
McCutcheon 2004	$^{40}Ar/^{39}Ar$	36.98 ± 0.78 Ma		Mt. Solo (SW 1/4 of Sec 25, T 8 N, R 3 W)