

G-probe 18 Summary Report
September 2017
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A total of twenty three labs submitted final results during this stage of the G-probe 18 study. Technique breakdown was, sixteen labs used LA-ICP-MS, four used SEM, four used EPMA and one provided information using miro-XRF. Four labs reported results using multiple techniques. The starting material used in glass preparation was a dolerite donated by Paul Olin at the University of Tasmania and identified as TAZDol-1G. An elevated concentration of tungsten was observed in this study. It is likely due to a contamination in the initial processing of the starting material. While it appears the contamination was uniformly distributed in the final glass material participants should use these results with caution.

Conversion of contributed dolerite material to a glass was accomplished at the USGS by melting 300 g of the dolerite in a one liter platinum bowl at 1325° C over a period of six hours. At the end of the melting period the molten material was poured into a platinum boat and rapidly lowered into a water bath for quenching. Twenty grams of random fragments were selected, ground and then split into representative aliquots for bulk analysis testing. Samples were analyzed for their total element content using techniques at the USGS and Agat Laboratories, Canada. If you have any questions or comments about this study please forward them to me at your earliest convenience.

Below you will find summary results for each element studied in this test. In the element diagrams you will find information for each technique providing a value. Also included is the target value (◆) and calculated precision ($X \pm Ha$) (♦) based on the Horowitz equation. A figure is also presented representing the data compilation for the entire study when more that one technique reported values. The study average is represented by ■, the standard deviation of the average by ■ and the maximum and minimum values by □. This study average is calculated primarily for the analysis of the major elements where multiple techniques provided data. For each technique an average value is presented (ex. LA-ICP-MS, ▲) as well as \pm one standard deviation (ex. LA-ICP-MS, ▲), and the maximum and minimum values reported (ex. LA-ICP-MS, △).

Table 1. Symbols used on figures 1 through 53

<u>Symbol type</u>		<u>Represents</u>
Large solid symbol,	●	Study or method average
Small solid symbol,	•	Study or method one standard deviation
Large open symbol,	○	Study or method Maximum or Minimum

Organizations interested in providing suitable starting materials for future G-probe studies are encouraged to contact Stephen Wilson at the U.S. Geological Survey (swilson@usgs.gov). Contributors of suitable starting materials will receive a complimentary portion of the produced glasses.

Table 2. Summary results for GP-18, TAZDol-1G

Oxide	Xa %/m/m	Ha %/m/m	s.d.m. %/m/m	GP-18 median	MAX %/m/m	Min %/m/m
SiO2	55.18	1.21	1.29	55.55	57.71	52.77
TiO2	0.78	0.03	0.08	0.76	0.87	0.45
Al2O3	15.90	0.42	0.37	15.92	16.70	15.19
Fe2O3	10.53	0.30	0.72	10.56	11.40	7.53
FeO	9.48	0.27	0.63	9.51	10.03	6.78
MnO	0.16	0.01	0.01	0.17	0.18	0.14
MgO	4.43	0.14	0.27	4.27	4.92	3.77
CaO	9.79	0.28	0.20	9.71	9.95	8.94
Nb2O	2.23	0.08	0.15	2.23	2.59	1.89
K2O	1.11	0.04	0.06	1.12	1.33	1.07
P2O5	0.10	0.01	0.01	0.11	0.13	0.08

Element	Xa mg/kg	Ha mg/kg	s.d.m. mg/kg	GP-18 median	MAX mg/kg	Min mg/kg
Ag	0.52	0.19	0.20	0.52	0.96	0.40
As	1.00	0.16	0.27	1.05	1.74	0.71
Au	0.00	0.00	0.01	0.02	0.04	0.01
B	13.33	1.44	4.64	4.92	16.53	3.54
Ba	232.47	16.38	54.86	233.07	250.40	6.70
Be	0.90	0.15	0.11	0.91	1.13	0.67
Bi	0.05	0.01	0.04	0.04	0.22	0.03
Br	-	-	-	-	-	-
Cd	0.13	0.03	0.12	0.18	0.45	0.03
Ce	31.08	2.96	1.34	31.17	32.62	27.49
Cl	-	-	-	-	-	-
Co	59.56	5.15	3.33	61.32	65.80	51.42
Cr	10.20	1.15	1.12	11.44	15.02	9.53
Cs	1.40	0.05	0.13	1.38	1.89	1.18
Cu	96.13	7.74	8.39	100.68	119.00	86.00
Dy	4.20	0.54	0.24	4.22	4.59	3.71
Er	2.75	0.38	0.17	2.68	2.89	2.30
Eu	0.95	0.15	0.05	0.97	1.03	0.81
F	-	-	-	-	-	-
Ga	17.23	1.80	2.35	17.09	22.02	10.48
Gd	3.95	0.51	0.21	3.85	4.22	3.42
Ge	1.67	0.25	0.72	1.75	3.24	1.11
Hf	3.41	0.45	0.14	2.96	3.24	2.74
Hg	0.00	-	0.08	0.85	0.00	0.00
Ho	0.95	0.15	0.05	0.89	0.96	0.74
I	-	-	-	-	-	-

Xa = Target value - USGS bulk analysis of glass fragments
 Ha = Target precision calculated using modified version of Horowitz equation
 for data quality 2 (Ha = 0.01Xa^{0.6495})
 s.d.m. = Standard deviation of population mean
 GP-18 med. = Median element concentration for all techniques reporting
 Max. = Maximum element/oxide concentration reported
 Min. = Minimum element/oxide concentration reported

Element	Xa mg/kg	Ha mg/kg	s.d.m. mg/kg	GP-18 median	MAX mg/kg	Min mg/kg
In	0.07	0.02	0.01	0.07	0.07	0.05
Ir	0.00	0.00	0.15	0.59	0.69	0.48
La	14.48	1.55	0.68	14.22	15.52	12.73
Li	13.93	1.50	0.89	13.13	14.80	11.74
Lu	0.45	0.08	0.02	0.40	0.44	0.36
Mn	1288	70	84	1290	1465	1189
Mo	0.52	0.09	0.05	0.45	0.56	0.31
Nb	6.21	0.75	0.39	6.06	6.94	5.28
Nd	15.08	1.60	0.71	15.41	16.34	13.34
Ni	42.93	3.90	2.56	42.92	48.30	37.00
Os	-	-	-	-	-	-
Pb	7.72	0.91	0.46	7.34	8.44	6.75
Pd	0.00	0.00	0.19	0.33	0.46	0.19
Pr	3.85	0.50	0.18	3.74	3.92	3.29
Pt	0.00	0.00	0.05	0.21	0.25	0.12
Rb	44.40	4.01	2.28	44.04	50.80	40.70
Re	-	-	-	-	-	-
Rh	-	-	-	-	-	-
Ru	-	-	-	-	-	-
S	-	-	-	-	-	-
Sb	0.24	0.05	0.08	0.18	0.38	0.11
Sc	41.38	3.78	2.72	38.44	44.55	32.58
Se	0.67	-	0.01	-	0.23	0.21
Sm	3.33	0.44	0.19	3.58	3.92	3.11
Sn	1.06	0.17	0.33	1.20	2.06	0.95
Sr	122.47	9.50	5.74	145.65	159.57	132.10
Ta	0.80	0.13	0.05	0.64	0.76	0.54
Tb	0.71	0.12	0.03	0.62	0.68	0.56
Te	-	-	-	-	-	-
Th	4.32	0.55	0.23	4.14	4.66	3.64
Tl	0.31	0.06	0.07	0.29	0.46	0.24
Tm	0.45	0.08	0.02	0.38	0.43	0.34
U	1.19	0.19	0.05	1.15	1.22	1.02
V	166.90	12.36	11.54	238.68	253.66	205.30
W	275.92	18.94	83.13	296.48	327.18	6.23
Y	27.06	2.63	1.50	24.42	26.28	20.90
Yb	2.92	0.40	0.15	2.68	2.93	2.35
Zn	89.42	7.27	8.55	95.17	110.00	76.62
Zr	126.25	9.75	5.35	111.28	119.30	99.00

Table 3 cont.

Lab Identifier Data Quality Method	7 2	7 2	8 2	8 2	9 2	9 2	10 2	10 2	11 2	11 2	11A 2	11A 2	
													EPMA
Elem/Cmpnd	units												
SiO2	% m/m	54.95	54.90	55.39	55.27	55.00	54.97	52.77	55.73	54.69	55.68		
TiO2	% m/m	0.75	0.75	0.75	0.76	0.76	0.78	0.77	0.80			0.79	0.78
Al2O3	% m/m	15.94	15.93	15.91	15.98	15.67	15.64	16.38	16.23	15.86	16.03		
Fe2O3T	% m/m	10.44	10.48	10.59	10.57	10.51	10.56	9.95	10.50	11.14	11.04		
Fe(II)O	% m/m	9.40	9.43	9.53	9.51	9.46	9.50	8.96	9.45	10.03	9.94		
MnO	% m/m	0.16	0.16	0.16	0.16	0.16	0.16	0.15	0.14			0.17	0.17
MgO	% m/m	4.29	4.30	4.26	4.28	4.28	4.27	4.27	4.10			4.39	4.37
CaO	% m/m	9.66	9.71	9.84	9.83	9.74	9.70	9.66	9.87	9.85	9.94		
Na2O	% m/m	2.07	2.04	2.22	2.18	2.26	2.30	2.35	2.31			2.24	2.26
K2O	% m/m	1.09	1.09	1.11	1.10	1.13	1.12	1.10	1.09			1.15	1.15
P2O5	% m/m	0.10	0.11	0.10	0.10								
Ag	mg/kg											0.40	0.86
As	mg/kg											1.05	1.18
Au	mg/kg											0.01	0.02
B	mg/kg											16.37	16.53
Ba	mg/kg											239.10	236.73
Be	mg/kg											0.90	0.98
Bi	mg/kg											0.03	0.04
Br	mg/kg												
Cd	mg/kg											0.16	0.20
Ce	mg/kg											31.56	31.46
Cl	mg/kg												
Co	mg/kg											62.87	62.33
Cr	mg/kg											13.20	15.02
Cs	mg/kg											1.47	1.51
Cu	mg/kg											103.57	112.43
Dy	mg/kg											4.59	4.56
Er	mg/kg											2.88	2.88
Eu	mg/kg											1.02	1.00
F	mg/kg												
Ga	mg/kg											17.35	17.16
Gd	mg/kg											4.16	4.22
Ge	mg/kg											2.34	2.25
Hf	mg/kg											3.10	3.23
Hg	mg/kg												
Ho	mg/kg											0.95	0.95
I	mg/kg												
In	mg/kg											0.07	0.07
Ir	mg/kg											0.48	0.69
La	mg/kg											14.87	14.90
Li	mg/kg											14.38	14.79
Lu	mg/kg											0.42	0.44
Mn	mg/kg												
Mo	mg/kg											0.45	0.48
Nb	mg/kg												
Nd	mg/kg											16.18	16.05
Ni	mg/kg											44.53	44.30
Os	mg/kg												
Pb	mg/kg											7.60	7.64
Pd	mg/kg												
Pr	mg/kg											3.85	3.81
Pt	mg/kg											0.14	0.25
Rb	mg/kg											46.39	45.87
Re	mg/kg												
Rh	mg/kg												
Ru	mg/kg												
S	mg/kg												
Sb	mg/kg											0.20	0.18
Sc	mg/kg											44.55	44.29
Se	mg/kg											0.23	0.21
Sm	mg/kg											3.84	3.81
Sn	mg/kg											1.14	1.32
Sr	mg/kg											159.57	159.47
Ta	mg/kg											0.62	0.61
Tb	mg/kg											0.66	0.65
Te	mg/kg												
Th	mg/kg											4.29	4.27
Tl	mg/kg											0.46	0.45
Tm	mg/kg											0.42	0.40
U	mg/kg											1.19	1.19
V	mg/kg											253.60	252.50
W	mg/kg											310.90	306.70
Y	mg/kg											25.67	25.66
Yb	mg/kg											2.93	2.86
Zn	mg/kg											83.33	84.17
Zr	mg/kg											118.43	118.90

Table 3 cont.

Lab identifier	Data Quality Method	12 2	12 2	13 2	13 2	4A 2	4A 2	14 2	14 2	15 2	15 2	16 2	16 2
Elem/Cmpnd	units	LA-ICP-MS	LA-ICP-MS	LA-ICP-MS	LA-ICP-MS	LA-ICP-MS	LA-ICP-MS	LA-ICP-MS	LA-ICP-MS	LAICPMS	LAICPMS	LAICPMS	LAICPMS
SiO2	% m/m									53.46	54.01	57.12	57.51
TiO2	% m/m									0.73	0.75	0.69	0.67
Al2O3	% m/m									15.32	15.57	int std	int std
Fe2O3T	% m/m									10.79	10.88	8.16	7.53
Fe(II)O	% m/m									9.71	9.79	7.34	6.78
MnO	% m/m									0.16	0.17	0.17	0.16
MgO	% m/m									4.16	4.25	3.90	3.80
CaO	% m/m									9.79	9.79	9.24	8.94
Na2O	% m/m									2.13	2.12	1.99	1.89
K2O	% m/m									1.07	1.07	1.16	1.07
P2O5	% m/m									0.10	0.09	0.08	0.08
Ag	mg/kg	0.56	0.63							0.47	0.49		
As	mg/kg	1.05	1.11							1.37	1.58		
Au	mg/kg	-	0.04							0.02	0.02		
B	mg/kg	-	-							4.66	4.54		
Ba	mg/kg	6.84	6.70	224.93	244.08	243.00	239.50	216.45	217.42	221.44	222.84	225.16	227.50
Be	mg/kg	-	-					0.84	0.73			BDL	BDL
Bi	mg/kg	0.03	0.03	0.22	0.07	0.03	0.03						
Br	mg/kg												
Cd	mg/kg	0.04	0.03							0.45	0.41	0.21	0.24
Ce	mg/kg	27.69	27.49	30.97	29.12	31.10	30.80	28.45	27.96	30.63	31.10	32.62	32.20
Cl	mg/kg												
Co	mg/kg	58.30	58.00			54.50	62.10	55.31	57.37	60.20	60.71	55.66	51.42
Cr	mg/kg	10.62	10.76					11.24	11.15	11.11	11.60	10.44	9.53
Cs	mg/kg	1.31	1.26			1.34	1.31	1.18	1.22	1.33	1.35	1.26	1.32
Cu	mg/kg	90.51	97.63			96.70	93.00	114.13	109.19	97.36	89.89	90.22	86.00
Dy	mg/kg	3.83	3.85	4.34	4.11	4.36	4.26	3.71	3.75	4.23	4.36	4.09	4.31
Er	mg/kg	2.43	2.45	2.74	2.61	2.88	2.75	2.30	2.41	2.68	2.79	2.56	2.63
Eu	mg/kg	0.81	0.84	1.03	0.97	1.03	0.98	0.91	0.94	0.96	0.96	1.01	1.01
F	mg/kg												
Ga	mg/kg	22.02	21.71	16.26	14.28			12.21	10.48	16.43	16.46	15.39	14.31
Gd	mg/kg	3.51	3.42	3.77	3.57	3.87	3.83	3.66	3.57	3.85	3.99	3.74	3.69
Ge	mg/kg	3.22	3.24	1.37	1.18					1.64	2.02	1.38	1.11
Hf	mg/kg	2.85	2.86	3.10	2.93	3.19	3.00	2.74	2.74			3.14	3.24
Hg	mg/kg												
Ho	mg/kg	0.85	0.79	0.90	0.84	0.94	0.94	0.74	0.82	0.88	0.91	0.90	0.93
I	mg/kg												
In	mg/kg	0.05	0.05	0.07	0.06	0.07	0.07			0.07	0.07		
Ir	mg/kg												
La	mg/kg	12.73	12.82	15.52	14.78	14.90	14.60	12.79	13.53	13.92	14.26	14.75	15.14
Li	mg/kg	-	-					11.82	11.74	12.85	12.33	13.30	13.68
Lu	mg/kg	0.36	0.36	0.44	0.41	0.40	0.41	0.36	0.38	0.40	0.41	0.42	0.42
Mn	mg/kg	1189.00	1194.00									1338.00	1249.60
Mo	mg/kg	0.37	0.37	0.43	0.31	0.49	0.51			0.44	0.47	0.45	0.55
Nb	mg/kg	5.28	5.36	6.60	6.35	6.94	6.61	6.32	6.00	5.80	5.82	5.67	5.43
Nd	mg/kg	13.34	13.56	14.85	14.08	16.20	15.90	14.15	14.86	15.19	15.41	16.34	15.81
Ni	mg/kg	39.80	41.10			41.50	42.10	41.19	48.27	41.57	40.87	39.98	37.00
Os	mg/kg												
Pb	mg/kg	6.98	7.07			7.07	7.03	6.89	6.94	6.93	6.88	7.77	7.89
Pd	mg/kg	0.19	0.46							n.d.	n.d.		
Pr	mg/kg	3.31	3.29	3.31	3.34	3.83	3.79	3.48	3.58	3.64	3.68		
Pt	mg/kg	0.15	0.24							0.21	0.12		
Rb	mg/kg	43.10	43.10			42.30	42.60	41.19	40.70	41.40	42.01	42.14	43.36
Re	mg/kg	-	-										
Rh	mg/kg	-	-										
Ru	mg/kg	-	-										
S	mg/kg	-	-										
Sb	mg/kg	0.20	0.23			0.16	0.16			0.34	0.38	BDL	BDL
Sc	mg/kg	34.50	34.70							38.99	39.61	32.58	33.94
Se	mg/kg	-	-										
Sm	mg/kg	3.11	3.17	3.35	3.20	3.92	3.79	3.37	3.34	3.49	3.63	3.69	3.64
Sn	mg/kg	1.23	1.22			1.54	1.78			0.96	1.01	1.08	0.97
Sr	mg/kg	132.46	132.10			148.70	150.00	140.48	135.61	144.30	146.08	144.50	151.56
Ta	mg/kg	0.56	0.54	0.73	0.71	0.75	0.76	0.62	0.66	0.63	0.60	0.67	0.68
Tb	mg/kg	0.56	0.56	0.63	0.60	0.64	0.62	0.62	0.62	0.60	0.65	0.63	0.66
Tc	mg/kg												
Th	mg/kg	3.78	3.79			4.49	4.39	3.64	3.85	4.02	3.97	4.52	4.66
Ti	mg/kg	0.24	0.25			0.29	0.29					0.29	0.30
Tm	mg/kg	0.35	0.35	0.41	0.38	0.43	0.40	0.35	0.37	0.38	0.39	0.38	0.39
U	mg/kg	1.05	1.04			1.11	1.11	1.02	1.04	1.10	1.09	1.20	1.21
V	mg/kg	222.40	221.70					238.94	225.79	238.42	241.97	224.16	205.30
W	mg/kg	6.38	6.23	327.18	302.34	304.00	307.00			291.99	296.82	293.60	308.80
Y	mg/kg	22.40	22.40	26.28	24.52	24.50	23.80	22.80	22.81	24.54	25.09	22.02	22.83
Yb	mg/kg	2.35	2.45	2.79	2.60	2.83	2.86	2.43	2.54	2.70	2.69	2.76	2.78
Zn	mg/kg	100.90	102.80					85.03	76.62	95.26	95.66	100.96	93.24
Zr	mg/kg	102.45	102.75	117.23	114.48	119.30	115.70	106.92	109.25	111.04	114.40	108.40	111.18

Table 3 cont.

Lab Identifier Data Quality Method	Elem/Cmpnd	units	1A	1A	5A	5A	17	17	18	18	19	19	20	20
			2	2	2	2	2	2	2	2	2	2	2	2
			LA-ICPMS	LA-ICPMS	LA-ICPMS	LA-ICPMS	LAICPMS	LAICPMS	LAICPMS	LAICPMS	LA-ICP-MS	LA-ICP-MS	LA-ICP-MS	LA-ICP-MS
	SiO2	% m/m							55.5	55.6			55.63	55.73
	TiO2	% m/m					0.45	0.45	0.77	0.76	0.76	0.76	0.78	0.78
	Al2O3	% m/m							16.50	16.40	16.20	16.30	16.02	15.94
	Fe2O3T	% m/m							9.99	10.10	10.80	10.80	10.57	10.69
	Fe(II)O	% m/m							8.99	9.09	9.72	9.72	9.52	9.63
	MnO	% m/m							0.17	0.17	0.17	0.17	0.17	0.16
	MgO	% m/m					4.35	4.35	3.78	3.77	3.85	3.85	4.27	4.25
	CaO	% m/m							9.64	9.59			9.93	9.84
	Na2O	% m/m					2.29	2.32	2.11	2.14	2.56	2.54	2.22	2.22
	K2O	% m/m							1.17	1.17	1.32	1.33	1.13	1.13
	P2O5	% m/m							0.10	0.10	0.13	0.13	0.12	0.12
	Ag	mg/kg	0.76	0.41					0.50	0.44			0.47	0.96
	As	mg/kg	0.91	0.92			1.42	1.74	0.85	0.99			1.03	1.01
	Au	mg/kg	0.02	0.02					0.01	0.02				
	B	mg/kg	3.67	3.54							11.30	11.40	5.13	5.09
	Ba	mg/kg	232.06	231.80	240.70	231.90	234.07	234.48	231.40	234.50	245.00	246.00	239.63	238.20
	Be	mg/kg	1.04	0.91	0.96	0.93	1.13	0.67			0.90	0.93	0.87	0.86
	Bi	mg/kg	0.04	0.03					0.03	0.03	0.04	0.04	0.04	0.04
	Br	mg/kg												
	Cd	mg/kg	0.08	0.08					0.19	0.20			0.16	0.16
	Ce	mg/kg	31.61	32.00	31.70	30.43	31.04	31.28	29.70	30.10	31.20	31.70	32.30	32.04
	Cl	mg/kg												
	Co	mg/kg	63.81	65.36	61.92	63.12	59.97	59.76	62.10	62.70	65.80	65.60	59.34	58.80
	Cr	mg/kg	11.39	11.71	11.66	11.30	13.21	12.71	11.10	11.20	12.80	12.80	11.48	11.15
	Cs	mg/kg	1.39	1.45	1.42	1.39	1.41	1.43	1.89	1.52	1.53	1.53	1.38	1.39
	Cu	mg/kg	102.32	107.99	98.50	103.70	106.60	102.46	93.10	100.20	119.00	116.00	99.50	98.40
	Dy	mg/kg	4.11	4.12	4.25	4.18	4.33	4.35	3.78	3.72	4.03	4.05	4.42	4.34
	Er	mg/kg	2.69	2.69	2.68	2.55	2.74	2.73	2.39	2.38	2.43	2.46	2.89	2.86
	Eu	mg/kg	0.98	0.98	0.94	0.91	0.98	0.98	0.93	0.93	0.94	0.93	0.98	0.97
	F	mg/kg												
	Ga	mg/kg	16.79	17.28	17.92	17.85			17.00	16.90	19.80	19.60	16.96	17.05
	Gd	mg/kg	3.95	3.92	3.85	3.65	4.04	3.96	3.43	3.43	3.77	3.76	3.96	3.97
	Ge	mg/kg	1.33	1.33	1.57	1.53					2.92	2.98	1.91	1.86
	Hf	mg/kg	2.88	2.87	3.07	2.95	3.09	3.16	2.74	2.74	2.96	2.99	3.13	3.11
	Hg	mg/kg											0.91	0.79
	Ho	mg/kg	0.86	0.86	0.88	0.86	0.94	0.96	0.80	0.79	0.83	0.84	0.91	0.91
	I	mg/kg												
	In	mg/kg							0.05	0.06				
	Ir	mg/kg												
	La	mg/kg	14.21	14.14	14.39	13.93	14.54	14.54	12.90	12.90	13.90	14.10	14.50	14.31
	Li	mg/kg	13.20	13.46	12.94	12.96	14.00	14.31	12.80	13.60	14.80	14.80	12.47	12.33
	Lu	mg/kg	0.38	0.39	0.41	0.39	0.43	0.40	0.36	0.36	0.37	0.37	0.42	0.42
	Mn	mg/kg	1361.05	1390.21	1310.00	1288.00	1279.01	1278.81	1280.00	1292.00	0.48	0.48	0.46	0.43
	Mo	mg/kg	0.48	0.48			0.51	0.56	0.42	0.44			6.40	6.33
	Nb	mg/kg	5.88	5.88	6.12	6.04	5.75	5.76	6.09	6.15	6.13	6.16	6.40	6.33
	Nd	mg/kg	15.30	15.60	15.32	14.81	15.59	15.53	14.50	14.50	15.20	15.30	16.07	15.71
	Ni	mg/kg	43.91	45.85	42.81	45.81	44.84	44.61	43.60	43.70	48.30	48.20	41.57	41.05
	Os	mg/kg												
	Pb	mg/kg	6.82	7.10	7.80	7.43	6.93	7.08	6.75	6.88	7.97	7.87	7.58	7.59
	Pd	mg/kg												
	Pr	mg/kg	3.76	3.76	3.74	3.66	3.88	3.92	3.54	3.56	3.70	3.73	3.92	3.88
	Pt	mg/kg	0.24	0.20										
	Rb	mg/kg	44.71	45.43	45.48	45.17	45.30	45.67	42.70	43.00	50.70	50.80	44.02	44.16
	Re	mg/kg												
	Rh	mg/kg												
	Ru	mg/kg												
	S	mg/kg												
	Sb	mg/kg	0.18	0.18					0.11	0.12			0.14	0.16
	Sc	mg/kg	39.81	40.07	39.52	40.23	37.58	36.88	34.90	34.60	38.10	38.40	39.80	39.06
	Se	mg/kg												
	Sm	mg/kg	3.57	3.53	3.64	3.31	3.70	3.69	3.37	3.38	3.56	3.54	3.66	3.64
	Sn	mg/kg	1.34	1.38					1.18	1.20	2.01	2.06	1.20	1.14
	Sr	mg/kg	149.00	147.39	149.40	147.10	144.65	144.94	145.00	144.00	145.00	147.00	150.10	148.88
	Ta	mg/kg	0.60	0.59	0.61	0.62	0.67	0.67	0.57	0.58	0.64	0.64	0.71	0.70
	Tb	mg/kg	0.60	0.61	0.62	0.61	0.68	0.66	0.56	0.56	0.59	0.60	0.68	0.66
	Te	mg/kg												
	Th	mg/kg	4.16	4.13	4.09	3.98	4.20	4.26	3.94	3.95	3.90	3.91	4.25	4.20
	Tl	mg/kg	0.29	0.28					0.25	0.26				
	Tm	mg/kg	0.37	0.38	0.38	0.37	0.43	0.42	0.34	0.35	0.36	0.36	0.41	0.41
	U	mg/kg	1.15	1.17	1.15	1.09	1.10	1.13	1.16	1.19	1.18	1.19	1.16	1.15
	V	mg/kg	249.57	253.66	242.00	243.40	226.89	225.52	244.00	246.00	249.00	250.00	236.36	234.63
	W	mg/kg	305.47	316.33			296.14	293.99	279.00	284.00			276.53	277.36
	Y	mg/kg	24.34	24.07	24.54	24.03	25.92	25.92	21.20	20.90	22.80	22.80	25.64	25.27
	Yb	mg/kg	2.63	2.64	2.66	2.59	2.71	2.71	2.44	2.44	2.51	2.51	2.83	2.80
	Zn	mg/kg	95.08	99.33	101.30	97.27	86.43	85.79	97.00	97.00	110.00	110.00	97.46	94.44
	Zr	mg/kg	111.39	110.47	112.70	111.40	110.22	111.61	100.00	99.00	106.00	106.00	118.97	117.38

Table 3 cont.

Lab identifier Data Quality Method	Elem/Cmpnd	units	8A	8A	21	21	22	22	23	23
			2	2	2	2	2	2	2	2
			LA-ICP-MS	LA-ICP-MS	LA-ICP-MS	LA-ICP-MS	LA-ICP-MS	LA-ICP-MS	LA-ICP-MS	LA-ICP-MS
SiO2	% m/m				56.56	56.53	57.28	57.71	57.69	52.78
TiO2	% m/m				0.74	0.75	0.78	0.77	0.73	0.73
Al2O3	% m/m				15.41	15.44	16.13	15.59	15.81	15.91
Fe2O3T	% m/m				10.69	10.69			11.40	10.93
Fe(II)O	% m/m				9.62	9.62	9.58	9.68		
MnO	% m/m				0.17	0.17	0.17	0.17	0.17	0.17
MgO	% m/m				4.25	4.29	4.33	4.27		
CaO	% m/m				9.68	9.71	9.80	9.56		
Na2O	% m/m				2.30	2.24	2.15	2.21		
K2O	% m/m				1.15	1.14	1.14	1.14		
P2O5	% m/m				0.12	0.12	0.12	0.13		
Ag	mg/kg				0.93	0.54				
As	mg/kg				1.32	1.15	0.79	0.71		
Au	mg/kg									
B	mg/kg				5.02	4.53	4.33	4.83		
Ba	mg/kg	248.38	250.40		227.78	227.63	236.20	237.33	225.15	227.06
Be	mg/kg				0.97	0.89				
Bi	mg/kg						0.04	0.05		
Br	mg/kg									
Cd	mg/kg									
Ce	mg/kg	31.67	32.24		30.79	30.82	32.36	31.60	31.13	31.41
Cl	mg/kg									
Co	mg/kg				61.67	62.17	61.03	60.87	62.41	61.61
Cr	mg/kg				10.91	10.79	12.17	12.19	11.88	13.25
Cs	mg/kg	1.32	1.32		1.41	1.40	1.32	1.36		
Cu	mg/kg				105.49	93.61	94.09	101.16	112.46	104.48
Dy	mg/kg	3.84	3.93		4.27	4.26	4.22	3.96	4.25	4.22
Er	mg/kg	2.45	2.50		2.76	2.75	2.66	2.52	2.77	2.81
Eu	mg/kg	0.97	0.98		0.96	0.97	0.98	0.96	0.95	1.00
F	mg/kg									
Ga	mg/kg				17.84	17.84	17.02	17.13	17.63	17.25
Gd	mg/kg	3.58	3.65		3.92	3.92	3.91	3.69	4.03	4.02
Ge	mg/kg									
Hf	mg/kg	2.88	2.95		3.00	2.97	3.09	2.93	2.90	2.96
Hg	mg/kg									
Ho	mg/kg	0.81	0.83		0.89	0.89	0.91	0.84	0.90	0.91
I	mg/kg									
In	mg/kg									
Ir	mg/kg									
La	mg/kg	14.05	14.46		14.11	14.13	14.24	13.95	14.20	14.37
Li	mg/kg				13.31	12.70	12.71	13.05		
Lu	mg/kg	0.36	0.37		0.41	0.40	0.42	0.40	0.39	0.40
Mn	mg/kg						1462.12	1464.91		
Mo	mg/kg				0.45	0.43	0.40	0.43		
Nb	mg/kg	6.61	6.71		5.88	5.90	6.21	6.22	5.74	5.80
Nd	mg/kg	15.19	15.41		15.64	15.56	15.64	15.33	15.49	15.51
Ni	mg/kg				43.79	43.73	42.53	42.95	42.89	42.37
Os	mg/kg									
Pb	mg/kg	8.44	8.23		7.61	7.48	7.03	7.25	7.89	7.94
Pd	mg/kg									
Pr	mg/kg	3.75	3.82		3.71	3.71	3.89	3.84	3.71	3.78
Pt	mg/kg									
Rb	mg/kg	43.97	43.77		44.84	44.41	45.52	46.62	44.06	43.35
Re	mg/kg									
Rh	mg/kg									
Ru	mg/kg									
S	mg/kg									
Sb	mg/kg									
Sc	mg/kg	37.11	37.59		38.53	38.88	39.24	37.87	38.26	38.47
Se	mg/kg									
Sm	mg/kg	3.48	3.55		3.61	3.62	3.61	3.50	3.59	3.71
Sn	mg/kg				0.98	0.95				
Sr	mg/kg	147.20	148.57		144.94	145.22	147.26	144.14	143.71	144.32
Ta	mg/kg	0.66	0.66		0.64	0.63	0.67	0.66	0.61	0.61
Tb	mg/kg	0.60	0.61		0.64	0.63	0.66	0.63	0.61	0.64
Te	mg/kg									
Th	mg/kg	4.08	4.16		4.17	4.14	4.14	4.00	4.40	4.43
Tl	mg/kg						0.31	0.33		
Tm	mg/kg	0.36	0.37		0.39	0.39	0.42	0.39	0.39	0.38
U	mg/kg	1.19	1.18		1.09	1.10	1.20	1.22	1.16	1.14
V	mg/kg				231.05	232.49	236.61	237.50	243.58	242.45
W	mg/kg				298.20	300.40	280.31	278.12		
Y	mg/kg	21.66	22.25		25.00	24.95	26.07	24.78	24.17	24.56
Yb	mg/kg	2.46	2.47		2.69	2.69	2.72	2.58	2.67	2.78
Zn	mg/kg				82.25	83.00	83.52	85.21	96.90	93.08
Zr	mg/kg	104.61	107.14		113.94	113.06	113.39	108.38	110.65	111.39













