

G-probe 21 Summary Report  
April 8, 2019  
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A total of twenty six labs submitted final results during this stage of the G-probe 21 study. Technique breakdown was, twenty two labs used LA-ICP-MS, three used SEM, and seven used EPMA. Four labs reported results using multiple techniques or provided multiple datasets. In a departure from previous G-probe studies the median concentration value determined in the study was used as the target value.

Starting material for this test sample was derived from an archived glass sample prepared in 1976 at the Corning Glass Works for the USGS. The starting material (GSE) was used as a six-step emission spectroscopy calibration material (Myers A.T., et al, 1976, USGS professional paper 1013). The glass was converted to a basalt matrix (BCR-2) through the addition of specific reagent grade compounds ( $\text{Fe}_2\text{O}_3$ ,  $\text{Al}_2\text{O}_3$ ,  $\text{MgO}$ ,  $\text{CaO}$ ,  $\text{TiO}_2$ ). Conversion of glass was accomplished at the USGS by melting 600 g in a one liter platinum bowl at  $1325^\circ\text{C}$  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.

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 than one technique reported values. The study median is represented by ■, the standard deviation of the median by ■ and the maximum and minimum values by □. This study median 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

Myers A.T., Havens R.G., Connor J.J., Conklin N.M., Rose H.J. Jr., Glass Reference Standards for the Trace-Element Analysis of Geologic Materials-Compilation of Interlaboratory Data, 1976 Geological Professional Paper 1013.

Table 2. Summary results for GP-21, GSE-2G

Oxide	Xa %m/m	Ha %m/m	s.d.m. %m/m	GP-21 median	MAX %m/m	Min %m/m
SiO2	53.37	1.17	1.71	53.37	57.75	49.96
TiO2	2.62	0.09	0.22	2.62	2.73	1.80
Al2O3	13.14	0.36	0.70	13.14	16.05	12.17
Fe2O3T	10.60	0.30	0.55	10.60	11.11	8.77
FeO(II)T	9.91	0.28	0.46	9.91	11.47	9.38
MnO	0.08	0.00	0.00	0.08	0.08	0.07
MgO	3.62	0.12	0.21	3.62	4.35	3.41
CaO	6.94	0.21	0.22	6.94	7.74	6.65
Nb2O	4.01	0.13	0.24	4.01	4.21	3.31
K2O	2.65	0.09	0.09	2.65	2.79	2.45
P2O5	0.40	0.02	0.12	0.40	0.81	0.20

Element	Xa mg/kg	Ha mg/kg	s.d.m. mg/kg	GP-20 median	MAX mg/kg	Min mg/kg
Ag	226.2	16.0	35.7	226.2	316.7	174.8
As	308.5	20.8	57.8	308.5	483.9	261.7
Au	11.0	1.2	1.3	11.0	12.4	8.3
B	340.1	22.6	60.2	340.1	557.7	285.0
Ba	422.0	27.2	157.7	422.0	1102.5	344.6
Be	445.8	28.5	64.0	445.8	592.8	339.7
Bi	324.9	21.8	41.5	324.9	458.8	269.2
Br	-	-	-	-	-	-
Cd	215.6	15.4	62.8	215.6	398.2	170.2
Ce	412.4	26.7	40.7	412.4	555.6	333.0
Cl	-	-	89.5	-	904.8	689.4
Co	369.0	24.2	60.6	369.0	572.9	307.6
Cr	372.4	24.4	39.5	372.4	512.3	306.7
Cs	308.9	0.1	31.4	308.9	428.5	257.8
Cu	379.6	24.8	53.7	379.6	494.3	218.4
DY	428.4	27.5	38.6	428.4	518.7	336.7
Er	420.2	27.1	37.9	420.2	481.4	327.9
EU	416.8	26.9	46.7	416.8	565.1	329.2
F	-	-	-	-	-	-
Ga	415.5	26.8	39.3	415.5	578.8	354.0
Gd	414.6	26.8	41.0	414.6	544.3	329.8
Ge	332.6	22.2	65.8	332.6	558.9	266.4
Hf	402.6	26.1	36.7	402.6	503.3	326.7
Hg	-	-	-	-	-	-
Ho	438.3	28.1	48.4	438.3	581.3	350.3
I	366.0	24.1	1.0	366.0	366.0	365.0

Element	Xa mg/kg	Ha mg/kg	s.d.m. mg/kg	GP-20 median	MAX mg/kg	Min mg/kg
In	371.6	24.4	101.1	371.6	667.5	338.2
Ir	1.0	0.2	108.0	1.0	188.0	0.8
La	391.1	26.5	38.4	391.1	535.1	317.4
Li	416.8	26.9	92.3	416.8	742.0	330.7
Lu	476.0	30.1	42.4	476.0	582.3	371.1
Mn	558.3	34.5	68.5	558.3	852.6	504.8
Mo	387.4	25.3	35.5	387.4	516.1	316.2
Nb	430.1	27.6	36.1	430.1	528.0	354.2
Nd	434.7	27.9	36.3	434.7	569.6	344.2
Ni	428.7	27.5	66.1	428.7	605.2	238.9
Os	-	-	-	-	-	-
Pb	403.8	26.2	40.0	403.8	558.1	342.1
Pd	177.1	13.0	85.9	177.1	333.4	128.4
Pr	411.6	26.6	36.5	411.6	543.6	331.7
Pt	14.0	1.5	12.2	14.0	36.3	10.2
Rb	371.9	24.4	36.2	371.9	518.9	318.3
Re	112.0	8.8	200.0	112.0	623.6	90.9
Rh	16.5	1.7	7.2	16.5	24.3	10.2
Ru	-	-	-	-	-	-
S	-	-	-	-	-	-
Sb	402.4	26.1	49.6	402.4	493.0	319.7
Sc	401.2	26.0	76.9	401.2	509.5	128.0
Se	19.2	2.0	10.2	19.2	44.5	16.6
Sm	434.2	27.8	39.0	434.2	563.8	340.6
Sr	296.9	20.2	38.9	296.9	435.9	250.0
Sr	445.4	28.5	51.9	445.4	606.1	305.5
Ta	418.1	27.0	50.4	418.1	552.2	334.9
Tb	425.3	27.4	41.1	425.3	562.6	340.2
Te	-	-	-	-	-	-
Th	440.4	28.2	61.8	440.4	555.8	243.9
Tl	5.9	0.7	0.9	5.9	8.0	4.8
Tm	437.3	28.0	49.6	437.3	545.6	343.6
U	405.1	26.3	41.6	405.1	567.4	336.9
V	415.2	27.4	49.2	415.2	568.2	356.8
W	415.2	26.8	71.8	415.2	660.1	353.6
Y	422.5	27.2	40.0	422.5	519.0	333.3
Yb	464.5	29.5	37.5	464.5	564.2	371.2
Zn	437.6	28.0	61.3	437.6	667.8	374.8
Zr	420.1	27.1	48.3	420.1	524.9	321.5

Xa = Target value - GP-20 compiled median results  
 Ha = Target precision calculated using modified version of Horowitz equation  
 for data quality 2 (Ha = 0.01Xa<sup>0.8495</sup>)  
 s.d.m. = Standard deviation of population mean  
 GP-21 med. = Median element concentration for all techniques reporting  
 Max. = Maximum element/oxide concentration reported  
 Min. = Minimum element/oxide concentration reported

Data quality LAB ID Oxide/Elem	GP-21 LA-ICPMS	GP-21 LA-ICP-MS	GP-21 LA-ICP-MS	GP-21 LA-ICP-MS	GP-21 LA-ICP-MS	GP-21 LA-ICP-MS	GP-21 LA-ICP-MS	GP-21 LA-ICP-MS	GP-21 LA-ICP-MS	GP-21 LA-ICP-MS	GP-21 LA-ICP-ns	GP-21 LA-ICP-Is
	2 1	2 2	2 2	2 3	2 3	2 4	2 5	2 5	2 6	2 6	2 6	2 6
SiO2, %	54.812			52.7	52.7	54.2	53.37	53.29				
TiO2	2.728			2.63	2.65	2.68	2.62	2.63				
Al2O3	13.281			15.0	16.1	13.1	13.35	13.32				
Fe2O3T	10.226			10.32	8.77	10.4						
Fe(II)O				11.47	9.75	9.38	9.72	9.81				
MnO	0.0775			0.08	0.08	0.08	0.08	0.08				
MgO	3.718			4.08	4.35	3.62	3.57	3.59				
CaO	7.277			7.11	7.74	7.13	7.09	7.11				
Na2O	4.018			3.31	3.56	4.14	4.12	4.11				
K2O	2.665			2.52	2.62	2.65	2.75	2.72				
P2O5	0.810			0.20	0.20	0.44	0.37	0.37				
Ag, mg/kg	212.020	201.1	199.8	184	192	238	175.6	174.8	250	219		
As	271.688	314.3	311.7			353			390	336		
Au	9.388	10.9	11.8						10.3	12.4		
B	333.246	349.6	353			310			362	285		
Ba	422.074	344.6	348.7	451	439	436	437.6	433.5	415	408		
Be	514.729	341.1	339.7			593	528.3	527.0	408	412		
Bi	306.754	269.2	269.9	323	317	334			358	302		
Br												
Cd	170.245	223.7	226.1	345	331	308			325	265		
Ce	409.604	333	336.3	421	438	420	432.7	431.9	391	393		
Cl												
Co	382.272	327.6	330.7	338	351	368	370.8	368.9	368	374		
Cr	377.496	325.8	329.4	361	370	409	384.0	384.3	360	357		
Cs	309.886	273.2	274	289	285	306	323.6	324.1	308	286		
Cu	218.354	310.9	304.1	299	327	381	359.6	355.2	383	346		
Dy	411.429	336.7	342.1	394	405	431	438.5	437.7	405	388		
Er	382.349	330.5	327.9	367	378	423	430.1	430.4	394	378		
Eu	398.997	329.2	332.5	437	445	422	420.4	418.1	389	382		
F												
Ga	400.634	382.5	383.4	354	371	426	431.2	429.6	416	389		
Gd	411.339	329.8	339.5	396	412	417	418.5	418.7	400	384		
Ge	319.334	333.4	332.6	282	293	402			417	350		
Hf	379.160	326.7	333.9	394	397	415	404.9	403.2	397	382		
Hg												
Ho	413.342	350.3	354.6	408	429	437	450.0	450.2	405	386		
I												
In	364.210	371.6	370.1	359	361				400	371		
Ir	188.004	0.84	1									
La	389.402	317.4	318.5	401	424	391	400.3	399.0	373	369		
Li	440.414	358	357.9	707	742	413	410.2	407.8	413	405		
Lu	440.918	371.1	374.4	464	477	481	480.5	479.9	445	405		
Mn		504.8	520.6	613	637				540	517		
Mo	397.433	337.5	337.8	354	345	413	400.6	397.4	373	357		
Nb	431.130	354.2	357	398	391	472	462.6	460.2	405	404		
Nd	417.998	344.2	347.3	432	447	437	442.7	439.5	409	405		
Ni	238.860	372.5	373.1	400	403	416	415.7	416.3	423	408		
Os												
Pb	373.448	342.1	344.9	381	368	459	429.7	427.1	420	365		
Pd		154.2	128.4									
Pr	405.644	331.7	334.6	410	428	421	440.7	438.7	388	384		
Pt	36.335	10.2	11.2									
Rb	356.983	320.6	321	346	339	381	372.1	371.7	373	344		
Re	108.441	90.93	91.7						107	91.7		
Rh		10.2	11.3									
Ru												
S		308	270									
Sb	445.451	335.2	336.5			360			397	359		
Sc	439.148	128	131.4	347	394	381	418.7	418.4	386	384		
Se	27.499	20	21.4						42.2	34.0		
Sm	418.873	340.6	342.9	430	441	430	437.1	437.6	410	404		
Sn	312.512	274.512	315.2	281	279	324			347	311		
Sr	453.888	368.8	373.9	440	445	459	466.9	467.3	440	430		
Ta	376.511	334.9	336.8	431	431	480	465.7	465.0	379	375		
Tb	402.020	340.2	344	407	427	442	449.1	449.1	393	379		
Te												
Th	399.417	243.9	248.3	455	441	446	447.6	446.7	400	388		
Tl	5.571	4.97	4.84				7.8	7.8	6.63	5.70		
Tm	399.743	343.6	347.8			440	461.8	461.1	395	375		
U	397.189	336.9	340.9	468	461	427	436.8	436.0	382	380		
V	451.262	357.6	356.8	444	436	415	417.4	416.2	400	404		
W	407.118	353.6	358.7	386	389	413	439.5	436.0	399	378		
Y	418.828	333.3	336.1	347	369	433	447.0	448.5	398	382		
Yb	435.055	371.2	374.8	438	445	487	489.1	488.0	444	425		
Zn	457.630	398.6	391.5	490	502	465	402.3	402.2	562	557		
Zr	419.343	321.5	325.5	348	369	421	430.0	427.2	388	380		

Data quality	GP-21 LA-ICP-MS	GP-21 La-ICP-MS	GP-21 LA-ICP-MS	GP-21 LA-ICP-MS	GP-21 LA-ICP-MS	GP-21 LA-ICP-MS	GP-21 LA-ICP-MS	GP-21 LA-ICP-MS	GP-21 LA-ICPMS	GP-21 LA-ICPMS	GP-21 LA-ICPMS	GP-21 LA-ICPMS
LAB ID	2	2	2	2	2	2	2	2	2	2	2	2
Oxide/Elem	7	7	8	8	9	10	10	11	11	12	12	12
SiO2, %						54.78	54.92					
TiO2						2.889	2.884					
Al2O3						13.56	13.49					
Fe2O3T												
Fe(II)O						10.19	10.19					
MnO						0.076	0.076					
MgO						3.71	3.68					
CaO						7.25	7.21					
Na2O						4.12	4.11					
K2O						2.64	2.63					
P2O5												
Ag, mg/kg	203.05	208.33			316.65	222.86	220.08	236.25	240.96			
As	334.38	338.01			483.90	269.25	272.84	275.24	286.20	308.5	305.3	
Au	11.10	11.52			12.19	10.02	11.34	8.27	8.88			
B					557.65			335.33	333.54	355.3	354.3	
Ba	418.25	427.24	383.91	379.74	558.55	447.15	443.37	412.80	415.71	415.6	411.9	
Be	455.50	448.64	363.87	394.38	574.60			461.38	468.16	442.9	439.3	
Bi			291.31	274.88	458.80	328.23	326.87	359.15	360.19	337.1	336.3	
Br												
Cd	272.90	281.25			398.17	207.46	206.37	201.48	205.33			
Ce	411.46	426.09	364.28	360.77	555.59	422.32	420.70	410.32	413.33	401.4	401.0	
Cl					904.80							
Co	350.56	352.41	329.16	324.56	520.80	366.46	367.55	387.66	390.79	372.9	371.9	
Cr	355.62	369.95	307.28	306.70	512.30	399.85	397.12	377.70	382.37	387.5	384.4	
Cs	273.52	280.89	264.69	257.78	428.50	325.27	322.40	317.81	321.50	317.3	317.7	
Cu	360.10	368.67	318.59	319.19	494.25	387.95	391.57	383.78	401.70	394.6	394.7	
Dy	498.40	505.05	454.75	472.27	518.65	445.48	444.41	425.36	425.61	415.5	414.2	
Er	481.44	481.28	362.44	455.81	478.07	431.84	431.87	419.50	420.98	406.0	404.2	
Eu	441.18	445.37	397.58	411.77	565.10	418.47	416.77	414.67	413.27	402.4	401.4	
F												
Ga	423.56	425.67			578.80	413.42	411.12	421.24	422.89	415.6	415.4	
Gd	491.23	488.66	402.73	411.75	544.30	428.88	427.67	438.42	433.46	411.1	409.1	
Ge					558.92	266.38	267.34	309.00	312.55	354.3	354.5	
Hf	491.32	503.31	392.94	411.83	496.22	406.00	405.28	402.25	402.88	394.2	392.0	
Hg												
Ho	483.41	488.96	436.71	443.81	551.35	440.07	439.95	434.09	433.89	418.3	417.1	
I												
In					571.53							
Ir												
La	428.04	460.45	381.95	381.27	535.13	399.60	398.76	390.67	389.08	379.8	378.0	
Li	382.86	374.82	340.40	330.74	609.95	423.39	416.13	425.74	422.44	432.2	432.5	
Lu	531.13	539.62	494.24	498.47	582.30	475.01	473.31	464.45	463.06	451.5	450.8	
Mn	538.33	549.91			852.55	590.95	590.24	587.26	592.08	558.3	556.3	
Mo			320.31	316.18	516.05	392.00	395.61	379.67	389.82	386.8	386.1	
Nb	447.27	465.99	450.71	449.82	528.00	472.22	474.81	427.96	427.90	429.0	427.5	
Nd	461.16	470.03	420.83	428.87	569.55	451.59	450.13	428.55	430.99	412.5	413.6	
Ni	398.17	393.31			605.15	436.52	437.69	446.06	445.66	431.9	425.4	
Os												
Pb	372.79	374.72	375.52	351.59	558.05	409.30	404.52	423.85	425.04	398.2	399.0	
Pd					177.10							
Pr	440.00	466.53	367.79	371.98	543.63	429.52	428.20	413.14	413.90	398.6	398.4	
Pt					16.78							
Rb	372.99	388.68	328.38	318.29	518.86	375.52	376.06	364.66	368.74	369.8	371.1	
Re					136.30							
Rh												
Ru												
S					589.15							
Sb			324.61	319.65	493.00	457.71	457.98	443.86	444.07	387.2	384.7	
Sc	399.25	412.99	408.78	415.94	509.46	404.13	403.20	416.13	418.25	389.5	388.4	
Se					44.45	17.35	18.39	18.28	16.60			
Sm	487.91	489.03	424.33	446.73	563.80	439.72	439.29	431.01	434.23	416.6	416.1	
Sn	289.36	308.38	298.70	293.61	435.87	276.07	276.63	288.03	292.08			
Sr	442.79	453.34	325.95	533.63	606.05	462.62	459.54	446.67	445.73	441.2	440.5	
Ta	525.71	528.95	484.12	488.13	552.20	461.60	463.20	403.17	403.44	403.2	402.1	
Tb	492.05	497.13	421.93	430.48	582.60	443.16	442.98	422.12	423.52	407.9	406.6	
Te												
Th	511.26	509.03	439.74	448.78	555.80	443.40	444.05	428.54	428.31	410.4	409.5	
Tl					7.97	5.90	5.68	6.06	6.44			
Tm	499.50	508.50	467.57	464.66	524.53	467.39	464.40	424.80	424.13	412.8	412.0	
U	373.47	369.73	401.07	397.00	567.40	434.05	432.36	413.80	413.50	395.9	395.9	
V	423.43	446.94	371.88	369.37	568.20	427.76	426.92	434.86	435.47	425.1	421.9	
W			397.46	394.70	576.40	432.03	434.12	422.04	428.49	415.0	413.7	
Y	480.68	474.67	401.75	413.60	516.95	438.77	438.63	426.25	427.33	414.0	412.6	
Yb	510.70	535.64	465.57	471.93	564.23	483.71	483.41	464.96	463.23	448.4	445.4	
Zn	374.75	378.37	399.17	394.11	667.75	461.52	459.40	468.02	473.01	430.6	429.0	
Zr	452.07	455.53	395.13	397.73	514.23	426.25	425.79	411.63	413.68	402.1	401.7	

Data quality LAB ID Oxide/Elem	GP-21	GP-21	GP-21	GP-21	GP-21 data	GP-21 data	GP-21	GP-21	GP-21	GP-21	GP-21	GP-21
	LA-ICP-MS	LA-ICP-MS	LA-ICP-MS	LA-ICP-MS	LA-ICP-MS	LA-ICP-MS	LA-ICP-MS	LA-ICP-MS	LA-ICP-MS	LA-ICP-MS	LA-ICP-MS	LA-ICP-MS
	2	2	2	2	2	2	2	2	2	2	2	2
	13	13	14	14	15	15	16	16	17	18	18	18
SiO2, %					53.72	53.76			50.92	50.4	50.0	
TiO2					2.708	2.705			2.11	1.88	1.80	
Al2O3					12.99	12.97				12.2	12.2	
Fe2O3T										10.7	10.7	
Fe(II)O					10.19	10.19						
MnO					0.0727	0.0729				0.0717	0.0720	
MgO					3.620	3.621				3.41	3.42	
CaO					7.040	7.024						
Na2O					3.986	3.992				3.64	3.64	
K2O					2.673	2.674				2.45	2.45	
P2O5	0.399	0.393			0.4267	0.4284						
Ag, mg/kg			236.5	243.4	248.4	249.2				226	226	
As			276.7	286.8	400.2	399.6				263	262	
Au												
B	411	415	342.4	340.1	309.9	309.5				301	312	
Ba	422	418	414.1	417.5	426.5	427.2	423.20	449.19	389	395	395	
Be	440	428	480.4	486.7	476.2	474.9			363	442	439	
Bi	364	367	361.5	372.4			282.28	298.55	319	346	322	
Br												
Cd			175.9	196.7	204.8	205.3			293	178	181	
Ce	398	393	410.6	418.8	422.9	422.8	428.60	425.87	384	391	396	
Cl			700	800								
Co	377	384	386.2	394.7	388.3	389.2			349	369	368	
Cr	367	370	374.8	388.1	402.4	402.1			356	358	355	
Cs	325	323	328.8	333.1	328.2	328.6			281	303	301	
Cu	389	399	398.6	411.8	418.2	415.8			366	378	385	
Dy	402	399	433.1	438.1	437.0	435.9	444.51	437.93	414	404	404	
Er	385	383	437.8	441.7	435.4	434.5	434.86	429.22	412	405	406	
Eu	379	378	416.9	421.4	422.8	422.2	424.15	422.04	369	401	377	
F												
Ga	441	446	429.7	430.3	440.3	441.3	374.37	382.87	406	398	395	
Gd	404	401	444.2	448.3	438.9	437.5	403.23	416.56	387	411	413	
Ge	443	444			332.7	334.3	295.30	305.91		306	302	
Hf	384	377	403.7	406.5	408.7	405.1	409.07	405.54	389	374	376	
Hg												
Ho	407	403	440.3	446.0	448.7	446.9	459.38	439.79	455	407	409	
I												
In			390.8	391.6	398.0	397.0	338.15	355.39	411	368	341	
Ir												
La	379	374	400.0	407.1	398.8	398.2	427.44	421.31	372	375	376	
Li	426	425	420.5	427.9	417.6	418.1			389	392	396	
Lu	432	427	481.2	478.6	487.0	484.5	492.87	481.17	489	435	436	
Mn	552	559	558.2	579.0	563.4	564.5			506			
Mo	386	388	396.5	400.1	399.8	400.2	351.07	401.80	386	370	369	
Nb	419	421	427.9	434.8	445.0	444.6	474.98	482.77	396	406	402	
Nd	416	414	439.6	444.5	447.1	446.3	440.22	437.39	412	417	425	
Ni	436	444	437.5	445.3	445.7	446.4			396	417	412	
Os												
Pb	407	407	422.0	436.2	434.6	435.5			403	395	397	
Pd					333.4	268.9						
Pr	407	406	415.0	423.4	429.1	428.5	425.54	416.71	392	393	396	
Pt												
Rb	402	403	376.1	381.7	378.3	378.8			327	345	344	
Re			111.9	112.1	116.6	116.4						
Rh					24.34	21.78						
Ru												
S												
Sb	397	389	446.2	446.8	454.3	454.8			366	414	408	
Sc	382	380	435.4	439.4	419.0	417.5			309	384	387	
Se										17.3	16.9	
Sm	410	409	435.9	441.4	440.2	438.8	434.09	439.15	396	406	405	
Sn	360	360	295.2	295.2	296.7	297.2			337	284	250	
Sr	433	432	453.1	459.3	458.5	458.3			400	440	407	
Ta	423	423	406.8	413.2	437.5	436.2	408.15	401.83	410	394	379	
Tb	404	401	429.5	435.2	441.0	439.8	433.15	436.56	416	397	400	
Te					368.3	363.5						
Th	406	401	442.3	439.7	445.4	443.7			460	358	435	
Tl					6.17	6.14			5.8	5.70	5.74	
Tm	399	395	434.2	435.0	447.5	446.0	440.93	429.17	456	398	401	
U	403	399	407.4	407.2	415.0	414.5			418	389	393	
V	408	406	433.7	438.5	426.6	428.7			379	415	414	
W			437.5	441.0	437.3	437.4	415.42	421.73	375	410	410	
Y	386	382	439.3	444.6	438.1	437.1	440.22	438.09	398	404	403	
Yb	423	419	464.0	473.0	470.8	469.7	465.41	458.84	452	434	437	
Zn	475	461	410.0	412.4	416.7	417.0			507	445	450	
Zr	387	385	423.1	428.1	422.2	421.0	446.37	446.81	383	388	403	

Data quality LAB ID Oxide/Elem	GP-21	GP-21	GP-21	GP-21	GP-21	GP-21	GP-21	GP-21	GP-21	GP-21	GP-21	GP-21	GP-21
	SEM	SEM	SEM	SEM	SEM	SEM	SEM	EPMA	EPMA	EPMA	EPMA	EPMA	EPMA
	2	2	2	2	2	2	2	2	2	2	2	2	2
	11	11	19	19	13A	13A	20	20	20	20	12A	12A	21
SiO2, %	51.21	51.36	53.22	53.27	57.7	57.7	53.5	52.4	53.195	53.231	55.169	55.223	
TiO2	2.69	2.69	2.63	2.66	2.5	2.6	2.61	2.56	2.457	2.460	2.617	2.625	
Al2O3	13.45	13.48	12.87	12.86	13.0	12.9	13.2	13.0	12.926	12.991	13.591	13.580	
Fe2O3T			11.06	11.05			10.60	10.64			10.599	10.568	
Fe(II)O	10.02	10.04			9.4	9.5			9.866	9.907			
MnO	0.08	0.08					0.068	0.069			0.074	0.082	
MgO	4.15	4.14	3.60	3.58	3.8	3.8	3.65	3.53	3.544	3.507	3.713	3.714	
CaO	6.84	6.87	6.89	6.89	6.8	6.8	7.06	6.97	6.906	6.896	6.663	6.648	
Na2O	4.21	4.19	3.96	3.95	4.1	4.1	4.18	4.12	3.946	3.994	3.651	3.631	
K2O	2.64	2.64	2.71	2.70	2.7	2.7	2.499	2.497	2.602	2.566	2.717	2.728	
P2O5							0.392	0.391			0.412	0.408	
Ag, mg/kg							290	300					
As													
Au													
B													
Ba							1057	1102					
Be													
Bi							274	284					
Br													
Cd							189	225					
Ce							495	479					
Cl							689	786					
Co							309	308					
Cr							362	358					
Cs							289	276					
Cu							275	266					
Dy													
Er													
Eu							535	507					
F													
Ga							387	390					
Gd							489	478					
Ge							329	334					
Hf													
Hg													
Ho							581	553					
I													
In							667	664					
Ir													
La													
Li													
Lu													
Mn							525	535					
Mo							395	411					
Nb													
Nd							471	456					
Ni							444	446					
Os													
Pb							406	400					
Pd													
Pr							387	400					
Pl													
Rb													
Re							624	619					
Rh													
Ru													
S													
Sb													
Sc													
Se													
Sm							475	474					
Sn							366	360					
Sr							306	392					
Ta							404	435					
Tb													
Te													
Th													
Tl													
Tm							545	546					
U													
V							567	557					
W							651	660					
Y													
Yb							471	481					
Zn							427	411					
Zr							525	513					

Data quality LAB ID Oxide/Elem	GP-21	GP-21	GP-20	GP-20	GP-20 data	GP-20 data	GP-21	GP-21
	EPMA	EPMA	EPMA	EPMA	LA-ICP-MS	LA-ICP-MS	EPMA	EPMA
	2	2	2	2	2	2	2	2
	22	22	14A	14A	13A	13A	23	23
SiO2, %	52.99	52.82	53.29	53.62	53.41	53.41	53.67	55.54
TiO2	2.688	2.887	2.57	2.58	2.58	2.59	2.62	2.61
Al2O3	13.05	12.92	13.25	13.32	12.95	12.99	13.41	13.31
Fe2O3T					10.52	10.46	11.11	11.02
Fe(II)O	10.22	10.21	9.57	9.74				
MnO	0.082	0.082					0.07	0.07
MgO	3.798	3.670	3.66	3.55	3.54	3.53	3.56	3.55
CaO	6.944	6.99	6.66	6.73	6.88	6.88	6.99	6.94
Na2O	4.08	4.04	4.01	4.00			3.57	3.62
K2O	2.638	2.65	2.60	2.64	2.69	2.67	2.79	2.78
P2O5	0.415	0.407	0.41	0.41			0.39	0.40
Ag, mg/kg								
As								
Au								
B								
Ba	559	481						
Be								
Bi								
Br								
Cd								
Ce								
Cl	892	881						
Co	573	570						
Cr	459	445						
Cs								
Cu								
Dy								
Er								
Eu								
F								
Ga								
Gd								
Ge								
Hf								
Hg								
Ho								
I								
In								
Ir								
La								
Li								
Lu								
Mn								
Mo								
Nb								
Nd								
Ni	601	584						
Os								
Pb								
Pd								
Pr								
Pt								
Rb	395	385						
Re								
Rh								
Ru								
S	60	64						
Sb								
Sc								
Se								
Sm								
Sn								
Sr	463	483						
Ta								
Tb								
Te								
Th								
Ti								
Tm								
U								
V	446	444						
W								
Y								
Yb								
Zn								
Zr	502	501						

Data quality LAB ID Oxide/Elem	GP21	GP-21	GP-21	GP-21	GP-21
	LA-ICP-MS	EPMA	EPMA	LA-ICP-MS	LA-ICP-MS
	2	2	2	2	2
	24	25	25	26	26
SiO2, %	52.97	55.95	55.85	52.85	55.19
TiO2	2.493	1.14	1.14	2.32	2.43
Al2O3	13.068	13.03	13.02	12.25	12.84
Fe2O3T				10.07	10.56
Fe(II)O	10.000	11.80	11.8	9.06	9.50
MnO	0.071	0.08	0.08		
MgO	3.578	3.52	3.54	2.98	3.13
CaO	8.972	6.42	6.43	6.52	6.84
Na2O	3.74	3.94	3.96	3.76	3.94
K2O	2.594	2.60	2.59	2.53	2.65
P2O5	0.388	0.31	0.31	0.35	0.40
Ag, mg/kg	236.9				
As	343.6			323.84	339.42
Au					
B				377.53	395.70
Ba	397.6			394.89	413.88
Be					
Bi	345.6				
Br					
Cd	279.2				
Ce	392			378.97	397.20
Cl					
Co	362.6			362.02	379.43
Cr	355.6			357.50	374.68
Cs	301.9			293.18	307.28
Cu	378.1			369.34	387.10
Dy	379			389.44	408.17
Er	373			376.57	394.67
Eu	379			373.48	391.45
F					
Ga	415.0				
Gd	376			378.78	396.99
Ge	406.9				
Hf	368			371.96	389.84
Hg					
Ho	385			395.11	414.11
I					
In	402.9				
Ir					
La	364			381.14	378.52
Li	408.5			408.48	428.13
Lu	409			418.76	438.90
Mn	539.1			540.67	566.67
Mo	376.4			359.93	377.23
Nb	405.4			397.26	416.37
Nd	386			390.25	409.02
Ni	414.8			416.83	436.88
Os					
Pb	395.3			386.94	384.59
Pd					
Pr	379.1			382.46	400.86
Pt					
Rb	368.6			356.78	373.94
Re	106.9				
Rh					
Ru					
S					
Sb	373.6			349.52	366.34
Sc	372				
Se					
Sm	387			390.09	408.85
Sn	344.3			327.24	342.98
Sr	424			421.16	441.41
Ta	369			374.82	392.85
Tb	375			380.25	398.53
Te					
Th	388			384.64	403.14
Ti	5.612				
Tm	377			389.25	407.98
U	394			381.49	399.84
V	404.0			398.41	417.57
W	411.1				
Y				380.46	398.75
Yb	409			410.10	429.83
Zn	461			456.06	478.00
Zr	369			372.39	390.30













