

G-probe 12 Summary Report

March 2014

Stephen Wilson

A total of seventeen labs/techniques submitted final results during this stage of the G-probe 12 study. Technique breakdown was, ten labs used LA-ICP-MS, and four used SEM, three utilized EPMA and one lab provided micro-XRF results. The material used to prepare the GSM-1G glass was a gabbro collected from the San Marcos Mountains which are part of the Southern California Batholith. This material was considered an intermediate silicate with a SiO₂ content less than 50%. The glass material was prepared at the USGS using the standard five hour melt (1350°C) and stir followed by quenching the molten mass in a water bath. Twenty grams of random fragments were selected, ground and then split into representative aliquots. Samples were analyzed for their total element content using techniques at the USGS and SGS minerals, 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 than 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, Δ).

Table 1. Symbols used on figures 1 through 52

<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

Table 2. Summary results for GP-12, GSM-1G

Oxide	Xa % m/m	Ha % m/m	s.d.m. % m/m	GP-12 AVG. % m/m	Max % m/m	Min % m/m
SiO2	46.10	1.036	4.161	47.15	55.33	37.50
TiO2	1.36	0.052	0.203	1.28	1.50	0.54
Al2O3	19.96	0.509	1.567	19.07	20.93	14.74
Fe2O3T	13.22	0.358	1.092	12.45	13.46	10.05
Fe(DDOT	11.89	0.328	0.994	11.49	12.36	9.51
MnO	0.15	0.008	0.036	0.14	0.18	0.01
MgO	4.51	0.144	0.633	4.45	6.32	3.16
CaO	12.71	0.347	1.799	12.40	18.39	10.40
Na2O	1.86	0.068	0.138	1.85	2.11	1.55
K2O	0.16	0.009	0.092	0.15	0.50	0.00
P2O5	0.04	0.003	0.005	0.04	0.04	0.03

Element	Xa mg/kg	Ha mg/kg	s.d.m. mg/kg	GP-12 AVG. mg/kg	Max mg/kg	Min mg/kg
Ag	<1	-	0.280	0.546	1.17	0.32
As	<30	-	0.420	1.716	2.40	1.01
Au	<1	-	0.208	0.429	0.91	0.28
B	12	1.32	1.46	5.134	7.53	3.40
Ba	85.6	7.01	6.13	76.11	88.10	64.94
Be	<5	-	0.035	0.246	0.29	0.21
Bi	0.17	0.036	0.033	0.080	0.13	0.02
Cd	0.25	0.049	0.024	0.095	0.14	0.07
Ce	4.567	0.581	0.483	4.923	5.99	4.13
Co	42.23	3.85	2.78	40.44	45.49	35.50
Cr	13.3	1.441	1.531	6.559	10.58	4.97
Cs	0.96	0.155	0.092	0.834	0.92	0.58
Cu	91.3	7.40	8.35	89.09	98.08	72.91
Dy	1.63	0.242	0.169	1.516	1.83	1.28
Er	0.98	0.157	0.115	0.891	1.08	0.724
Bu	1.37	0.209	0.070	1.054	1.14	0.91
Ga	17.6	1.83	9.85	23.24	45.92	15.02
Gd	3.81	0.498	0.479	3.526	4.42	2.73
Ge	2	0.288	3.81	3.49	11.89	1.01

Element	Xa mg/kg	Ha mg/kg	s.d.m. mg/kg	GP-12 AVG. mg/kg	Max mg/kg	Min mg/kg
Hf	2	0.288	0.36	2.41	3.07	1.82
Ho	0.3233	0.061	0.035	0.311	0.381	0.259
In	<0.2	-	0.014	0.050	0.073	0.030
La	1.93	0.280	0.371	1.796	2.140	0.809
Li	<10	-	1.292	6.333	8.247	3.81
Lu	0.1366	0.029	4.407	1.59	14.34	0.09
Mn	1183	65.2	105.9	1271.1	1406.2	1161.9
Mo	<2	-	0.114	0.447	0.594	0.226
Nb	<1	-	0.097	0.815	0.984	0.646
Nd	3.4	0.452	0.285	3.637	4.1	3.133
Ni	22.66	2.27	1.364	12.70	14.30	9.47
Pb	15	1.60	1.104	11.218	12.79	9.22
Pt	0.73	0.122	0.053	0.715	0.809	0.623
Pt	<1	-	0.592	0.883	1.69	0.456
Rb	6.3	0.764	0.452	4.771	5.406	3.87
Sb	2.033	0.292	0.172	1.767	2.03	1.477
Sc	39.33	3.620	5.041	35.59	41.80	25.92
Se	<1	-	0.029	0.069	0.107	0.044
Sm	1	0.160	0.126	1.109	1.34	0.831
Sn	2.67	0.368	0.722	1.877	3.89	1.10
Sr	399.3	25.93	26.01	365.7	414.6	326.0
Ta	<0.5	-	0.01	0.05	0.081	0.026
Tb	0.25	0.049	0.025	0.226	0.267	0.182
Th	0.367	0.068	0.041	0.449	0.508	0.373
Tl	<0.5	-	0.052	0.107	0.239	0.063
Tm	0.127	0.028	0.015	0.126	0.152	0.102
U	0.197	0.040	0.051	0.193	0.370	0.130
V	616.3	37.49	59.64	580.6	672.6	445.5
W	<1	-	0.040	0.188	0.223	0.095
Y	9.03	1.04	0.899	8.244	9.450	6.495
Yb	0.866	0.142	0.095	0.853	1.020	0.670
Zn	101	8.067	9.92	92.57	105	74.63
Zr	24.33	2.407	1.80	24.65	27	21.08

Xa = Target value - USGS bulk analysis of glass fragments and W-2 certificate values

Ha = Target precision calculated using modified version of Horowitz equation
for data quality 2 (Ha = 0.01Xa^{0.8895})

s.d.m. = Standard deviation of population mean
mean = Mean element concentration for all techniques reporting
Max. = Maximum element/oxide concentration reported
Min. = Minimum element/oxide concentration reported











