



**Date Submitted:** 21-Sep-15  
**Invoice No.:** A15-07940  
**Invoice Date:** 06-Oct-15  
**Your Reference:** PF6995

MINNESOTA DEPT OF NAT RESOURCES  
500 LAFAYETTE RD BOX 45  
ST PAUL MN 55155-4045  
United States

ATTN: Matt Oberhelman

## CERTIFICATE OF ANALYSIS

8 Rock samples were submitted for analysis.

The following analytical package was requested:

Code 4B (1-10) Major Elements Fusion ICP(WRA)  
Code 4F-C, S Infrared

REPORT      **A15-07940**

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Notes:

Total includes all elements in % oxide to the left of total.

CERTIFIED BY:

A handwritten signature in black ink, appearing to read "Emmanuel Esemé". The signature is written in a cursive style with some loops and flourishes.

Emmanuel Esemé , Ph.D.  
Quality Control



## Results

Analyte Symbol	SiO2	Al2O3	Fe2O3(T)	MnO	MgO	CaO	Na2O	K2O	TiO2	P2O5	LOI	Total	Ba	Sr	Y	Sc	Zr	Be	V	C-Total	Total S
Unit Symbol	%	%	%	%	%	%	%	%	%	%	%	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	%
Lower Limit	0.01	0.01	0.01	0.001	0.01	0.01	0.01	0.01	0.001	0.01		0.01	2	2	1	1	2	1	5	0.01	0.01
Method Code	FUS-ICP	FUS-ICP	FUS-ICP	FUS-ICP	FUS-ICP	FUS-ICP	FUS-ICP	FUS-ICP	FUS-ICP	FUS-ICP	FUS-ICP	FUS-ICP	FUS-ICP	FUS-ICP	FUS-ICP	FUS-ICP	FUS-ICP	FUS-ICP	FUS-ICP	CS	CS
C-057A	49.15	31.69	0.93	0.015	0.37	15.14	2.68	0.11	0.076	< 0.01	0.75	100.9	32	386	6	2	5	< 1	17	0.01	< 0.01
C-057B	50.53	27.12	1.78	0.032	2.01	13.55	2.69	0.14	0.070	0.01	0.88	98.81	59	406	6	4	4	< 1	26	0.01	< 0.01
C-057C	50.05	29.76	0.87	0.012	0.37	14.05	2.97	0.15	0.064	0.02	0.73	99.04	62	425	6	1	5	< 1	12	< 0.01	< 0.01
C-057D	49.74	30.22	1.15	0.017	0.86	14.35	2.80	0.16	0.063	< 0.01	0.59	99.92	67	405	6	2	4	< 1	13	< 0.01	< 0.01
C-057E	50.06	29.33	0.85	0.010	0.24	14.23	2.93	0.17	0.063	< 0.01	0.93	98.81	83	471	6	< 1	5	< 1	13	< 0.01	< 0.01
L-205A	53.00	26.78	2.82	0.031	1.02	11.70	3.78	0.42	0.879	0.06	0.19	100.7	160	444	9	5	30	< 1	52	0.02	< 0.01
L-159A	51.92	20.77	7.64	0.097	2.23	10.52	3.04	0.64	1.160	0.16	0.59	98.77	198	351	17	18	91	< 1	171	< 0.01	< 0.01
L-231A	50.43	24.19	7.09	0.078	3.44	10.09	3.38	0.65	0.928	0.02	-0.12	100.2	201	401	9	6	80	< 1	86	0.01	< 0.01

QC

Analyte Symbol	SiO2	Al2O3	Fe2O3(T)	MnO	MgO	CaO	Na2O	K2O	TiO2	P2O5	Ba	Sr	Y	Sc	Zr	Be	V	C-Total	Total S	LOI	Total	
Unit Symbol	%	%	%	%	%	%	%	%	%	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	%	%	%	
Lower Limit	0.01	0.01	0.01	0.001	0.01	0.01	0.01	0.01	0.001	0.01								0.01	0.01		0.01	
Method Code	FUS-ICP	FUS-ICP	FUS-ICP	FUS-ICP	FUS-ICP	FUS-ICP	FUS-ICP	FUS-ICP	FUS-ICP	FUS-ICP	FUS-ICP	FUS-ICP	FUS-ICP	FUS-ICP	FUS-ICP	FUS-ICP	FUS-ICP	CS	CS	FUS-ICP	FUS-ICP	
NIST 694 Meas	11.71	1.87	0.74	0.010	0.36	43.89	0.86	0.55	0.120	30.24							1648					
NIST 694 Cert	11.2	1.80	0.790	0.0116	0.330	43.6	0.860	0.510	0.110	30.2							1740					
DNC-1 Meas	47.35	17.99	9.84	0.150	10.19	11.23	1.85	0.23	0.480	0.06	105	141	16	31	36		155					
DNC-1 Cert	47.15	18.34	9.97	0.150	10.13	11.49	1.890	0.234	0.480	0.070	118	144.0	18.0	31	38		148					
GBW 07113 Meas	71.82	12.66	3.19	0.140	0.15	0.58	2.36	5.30	0.281	0.04	496	40	49	5	406	4	7					
GBW 07113 Cert	72.8	13.0	3.21	0.140	0.160	0.590	2.57	5.43	0.300	0.0500	506	43.0	43.0	5.00	403	4.00	5.00					
BaSO4 Meas																					14.6	
BaSO4 Cert																					14.0	
BaSO4 Meas																					14.5	
BaSO4 Cert																					14.0	
BaSO4 Meas																					14.4	
BaSO4 Cert																					14.0	
W-2a Meas	52.76	15.41	10.80	0.170	6.40	10.82	2.18	0.63	1.080	0.13	175	196	19	35	90	< 1	279					
W-2a Cert	52.4	15.4	10.7	0.163	6.37	10.9	2.14	0.626	1.06	0.130	182	190	24.0	36.0	94.0	1.30	262					
SY-4 Meas	50.51	20.90	6.25	0.110	0.53	7.74	7.33	1.79	0.290	0.13	359	1220	119	1	516	3	8					
SY-4 Cert	49.9	20.69	6.21	0.108	0.54	8.05	7.10	1.66	0.287	0.131	340	1191	119	1.1	517	2.6	8.0					
BIR-1a Meas	48.23	15.74	11.42	0.170	9.84	13.37	1.76	0.02	0.990	0.03	7	107	14	44	17	< 1	337					
BIR-1a Cert	47.96	15.50	11.30	0.175	9.700	13.30	1.82	0.030	0.96	0.021	6	110	16	44	18	0.58	310					
SGR-1b Meas																			29.0	1.61		
SGR-1b Cert																			28	1.53		
SGR-1b Meas																			29.3	1.60		
SGR-1b Cert																			28	1.53		
GS311-4 Meas																			1.07	0.52		
GS311-4 Cert																			1.11	0.54		
GS311-4 Meas																			1.08	0.54		
GS311-4 Cert																			1.11	0.54		
GS900-5 Meas																			0.64	0.34		
GS900-5 Cert																			0.65	0.34		
GS900-5 Meas																			0.63	0.35		
GS900-5 Cert																			0.65	0.34		
L-205A Orig																			0.02	< 0.01		
L-205A Dup																			0.02	< 0.01		
L-231A Orig	50.50	24.47	7.16	0.077	3.41	10.08	3.39	0.65	0.946	0.02	202	406	9	6	84	< 1	85				-0.12	100.6
L-231A Dup	50.37	23.91	7.03	0.078	3.47	10.11	3.38	0.64	0.909	0.02	201	396	9	6	77	< 1	86				-0.12	99.79