SDMS Document ID
1062388

Statistical Information

Material	Labs	Method	Mean	Units	E-691 Statistics Sr	SR	r	R	%R
Mine Waste Rock	8	Time	27.5	Hours	0.468	5.08	1.31	14.2	52
Heap Leach Spoils	8	Time	26.7	Hours	1.92	4.01	5.38	11.2	42
Mine Waste Rock	8	Temperature	21.7	Degrees C	0.025	2.15	0.07	6.02	28
Heap Leach Spoils	8	Temperature	21.8	Degrees C	0	2.12	0	5.34	24
Mine Waste Rock	8	Volume	4.99	Liters	0.0696	0.0696	0.195	0.195	4
Heap Leach Spoils	8	Volume	5.05	Liters	0.0562	0.230	0.147	0.643	13
Mine Waste Rock	8	Moisture	18.1	% H2O	1.00	1.23	2.80	3.45	19
Heap Leach Spoils	8	Moisture	11.7	% H2O	0.379	1.11	1.06	3.11	27
Mine Waste Rock	8	Extractant pH	5.61	pH	0	0.205	0	0.579	10
Heap Leach Spoils	8	Extractant pH	5.61	pH	0	0.205	0	0.579	10
Mine Waste Rock	8	Effluent pH	2.79	pH	0.0561	0.122	0.157	0.341	12
Heap Leach Spoils	8	Effluent pH	8.43	pH	0.101	0.265	0.282	0.741	9
Mine Waste Rock	8	Acidity	506	ug/g	44.5	115	125	321	63
Heap Leach Spoils	8	Alkalinity	81.5	ug/g	10.5	12.4	29.3	34.6	42
Mine Waste Rock	8	Dissolved Solids	1130	ug/g	175	262	409	734	65
Heap Leach Spoils	8	Dissolved Solids	671	ug/g	69.9	79.8	196	224	33
Mine Waste Rock	8	Aluminum ICP	43.0	ug/g	3.30	6.83	9.23	19.1	44
Heap Leach Spoils	8	Aluminum ICP	0.0884	ug/g	0.0476	0.0801	0.133	0.224	253
Heap Leach Spoils	8	Arsenic ICP	0.238	ug/g	0.0235	0.0306	0.0660	0.0856	36
Mine Waste Rock	8	Barium ICP	0.0239	ug/g	0.00584	0.00987	0.0163	0.0276	115
Heap Leach Spoils	8	Barium ICP	0.0390	ug/g	0.0218	0.0318	0.0611	0.0889	228
Heap Leach Spoils	8	Boron ICP	0.323	ug/g	0.0177	0.0368	0.0495	0.103	32
Mine Waste Rock	8	Cobalt ICP	0.0559	ug/g	0.0200	0.0200	0.0561	0.0561	100
Heap Leach Spoils	8	Cobalt ICP	0.0997	ug/g	0.0114	0.0143	0.0320	0.0400	40
Mine Waste Rock	8	Chromium ICP	0.0893	ug/g	0.0263	0.0306	0.0737	0.0857	96
Mine Waste Rock	8	Copper ICP	2.38	ug/g	0.208	0.458	0.581	1.28	54
Mine Waste Rock	8	Iron ICP	39.3	ug/g	3.31	9.47	9.26	26.53	68
Heap Leach Spoils	8	Iron ICP	0.148	ug/g	0.0336	0.0401	0.0942	0.112	76
Mine Waste Rock	8	Potassium ICP	5.06	ug/g	0.890	1.61	2.49	4.5	89
Heap Leach Spoils	8	Potassium ICP	7.01	ug/g	0.281	0.470	0.786	1.32	19
Mine Waste Rock	8	Lithium ICP	0.0753	ug/g	0.0240	0.0240	0.0672	0.0672	89
Heap Leach Spoils	8	Lithium ICP	0.0486	ug/g	0.0162	0.0162	0.0454	0.0454	93
Mine Waste Rock	8	Magnesium ICP	18.0	ug/g	1.37	2.67	3.83	7.49	42
Heap Leach Spoils	8	Magnesium ICP	5.40	ug/g	0.542	0.542	1.52	1.52	28
Mine Waste Rock	8	Manganese ICP	3.83	ug/g	0.333	0.589	0.931	1.65	43
Heap Leach Spoils	8	Molybdenum ICP	0.0481	ug/g	0.0135	0.0140	0.0377	0.0392	81
Mine Waste Rock	8	Sodium ICP	5.62	ug/g	1.21	1.69	3.39	4.73	84
Heap Leach Spoils	8	Sodium ICP	138	ug/g	7.50	10.7	21.0	29.8	22
Mine Waste Rock	8	Nickel ICP	0.245	ug/g	0.0187	0.0400	0.0529	0.112	46
Mine Waste Rock	8	Lead ICP	2.71	ug/g	0.117	0.260	0.328	0.727	27
Mine Waste Rock	8	Strontium ICP	0.286	ug/g	0.0276	0.0367	0.0773	0.103	36
Heap Leach Spoils	8	Strontium ICP	0.563	ug/g	0.0553	0.0553	0.155	0.155	28
Heap Leach Spoils	8	Vanadium ICP	0.0366	ug/g	0.0102	0.0114	0.0286	0.0318	87
Mine Waste Rock	8	Zinc ICP	21.8	ug/g	1.90	3.68	5.33	10.3	47

Table . - ILS MWMP Extraction Test Data Comparison

MWMP Sample	Parameter	Units	ILS Laboratory Number 1	2	3	4	5	6	7	8	Avg.	Max. Dev. from Avg.	Precision, Percent
USW-A	pH-Extraction H_2O	s.u	5.57	5.78	6.0	5.68	5.49	5.51	5.33	5.55	5.61	0.39	93.5
USW-B	pH-Extraction H_2O	s.u	5.57	5.78	6.0	5.68	5.49	5.51	5.33	5.55	5.61	0.39	93.5
NHR-A	pH-Extraction H_2O	s.u	5.57	5.78	6.0	5.68	5.49	5.51	5.33	5.55	5.61	0.39	93.5
NHR-B	pH-Extraction H_2O	s.u	5.57	5.78	6.0	5.68	5.49	5.51	5.33	5.55	5.61	0.39	93.5
USW-A	pH-Effluent	s.u	2.58	2.60	2.90	2.77	2.77	2.82	2.88	2.89	2.78	0.20	92.8
USW-B	pH-Effluent	s.u	2.60	2.70	2.92	2.77	2.79	2.98	2.82	2.79	2.80	0.20	92.9
NHR-A	pH-Effluent	s.u	8.30	8.40	8.80	8.45	8.07	8.49	8.15	8.62	8.41	0.39	95.6
NHR-B	pH-Effluent	s.u	8.63	8.30	8.85	8.37	8.07	8.66	8.09	8.66	8.45	0.40	95.5
USW-A	pH-Extract	s.u	2.58	2.80	2.90	2.81	2.78	2.93	2.75	2.89	2.80	0.22	92.1
USW-B	pH-Extract	s.u	2.64	2.81	2.92	2.82	2.80	3.13	2.57	2.79	2.81	0.32	89.8
NHR-A	pH-Extract	s.u	8.41	8.61	8.80	8.36	8.39	8.43	7.46	8.25	8.34	0.88	89.4
NHR-B	pH-Extract	s.u	8.58	8.41	8.85	8.35	8.58	8.41	7.67	8.36	8.40	0.73	91.3
USW-A	Extraction Time	hrs.	28.5	36.5	25.5	19.5	28.0	24.0	32.0	26.5	27.6	8.9	75.6
USW-B	Extraction Time	hrs.	29.0	36.5	24.5	20.5	27.5	24.0	32.0	25.5	27.4	9.1	75.1
NHR-A	Extraction Time	hrs.	24.5	27.7	22.0	26.0	24.0	25.0	26.0	32.5	26.0	6.5	80.0
NHR-B	Extraction Time	hrs.	24.0	34.5	24.0	27.5	24.0	25.0	26.0	35.0	27.5	7.5	78.6
USW-A	Extraction Temp.	°C	20.7	25.1	22.0	22.0	21.0	18.0	24.0	21.0	21.7	3.7	82.9
USW-B	Extraction Temp.	°C	20.7	25.0	22.0	22.0	21.0	18.0	24.0	21.0	21.7	3.7	82.9
NHR-A	Extraction Temp.	°C	20.7	25.0	22.0	22.0	21.0	18.0	24.0	21.0	21.7	3.7	82.9
NHR-B	Extraction Temp.	°C	20.7	25.0	22.0	22.0	21.0	18.0	24.0	21.0	21.7	3.7	82.9
USW-A	Effluent Vol.	liters	5.08	5.03	5.00	5.00	4.90	5.00	4.80	5.02	4.98	0.18	96.4
USW-B	Effluent Vol.	liters	4.90	5.04	5.00	5.00	4.97	5.00	5.00	5.03	4.99	0.09	98.2
NHR-A	Effluent Vol.	liters	5.46	5.30	5.00	5.00	5.10	4.60	5.00	5.02	5.06	0.46	90.9
NHR-B	Effluent Vol.	liters	5.26	5.33	5.00	5.00	5.13	4.65	5.00	5.02	5.05	0.40	92.1
USW-A	Residual Moisture	wt. %	18.4	18.4	21.0	17.0	18.5	15.2	18.3	16.8	18.0	3.0	85.7
USW-B	Residual Moisture	wt. %	18.6	18.1	19.0	18.0	18.8	16.5	17.7	17.4	18.0	1.5	91.7
NHR-A	Residual Moisture	wt. %	11.8	11.2	14.0	11.2	10.8	12.7	11.6	11.1	11.8	2.2	84.3
NHR-B	Residual Moisture	wt. %	11.7	11.1	14.0	11.1	9.9	11.5	11.4	11.4	11.5	2.5	82.1

Notes: Extract volume was arbitrary as long as sufficient volume for analysis was obtained. Extract volumes were, consequently, not included in the table.
Filter pore size was 0.45μm for all ILS laboratories.

Bias Information

Lab No.		C-170099		C-170100		C-170101		C-170102			
Field No.		9-19989	Reference	9-22240	Reference	9-22242	Reference	9-22469	Reference	Bias	% Bias
Ag	ug/L	<10		290	323	<10		<10			-33
Al	mg/L	0.011		0.47	0.534	<0.01		<0.01			-0.064
As	ug/L	<100		330	493	<100		<100			-163
B	ug/L	33		130	317	260		41			-187
Ba	ug/L	<1		960	1233	1.7		3.1			-273
Be	ug/L	<10		260	340	<10		<10			-80
Ca	mg/L	<0.1		<0.1		<0.1		14	18.0		-4.0
Cd	ug/L	<10		180	215	<10		<10			-35
Co	ug/L	<10		660	873	<10		<10			-213
Cr	ug/L	<10		630	795	<10		<10			-165
Cu	ug/L	<10		880	930	<10		<10			-50
Fe	mg/L	<0.05		0.54	0.675	<0.05		<0.05			-0.135
K	mg/L	<0.1		0.49		0.2		25	28.3		-3.3
Li	ug/L	470	500	<10		<10		<10			-30
Mg	mg/L	<0.1		<0.1		<0.1		19	21.5		-2.5
Mn	ug/L	<10		500	616	<10		<10			-116
Mo	ug/L	<20		<20		300	548	25			-248
Na	mg/L	0.26		0.16		<0.1		45	51		-6.0
Ni	ug/L	<10		530	617	<10		<10			-87
Pb	ug/L	<100		470	568	<100		<100			-98
Sb	ug/L	<100		<100		300	709	<100			-409
Sr	ug/L	1.5		560	652	<1		4.5			-92
Ti	ug/L	76	100	<50		<50		<50			-24
V	ug/L	<10		820	961	<10		<10			-141
Zn	ug/L	<10		650	832	<10		<10			-182

Bias

Table . - Analytical Resutls Comparison, ILS Laboratory Water Samples Preserved for Metals (Sample I.D. = LW-M)

Metal, mg/L	ILS Laboratory Number 1	2	3	4	5	6	7	8	Avg.	Max Dev. from Avg.	Precision, Percent
Ag	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0	100.0
Al	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0	100.0
As	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	0	100.0
B	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0	100.0
Ba	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0	100.0
Co	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0	100.0
Cr	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0	100.0
Cu	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0	100.0
Fe	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0	100.0
K	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0	100.0
Li	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0	100.0
Mg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0	100.0
Mn	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0	100.0
Mo	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	0	100.0
Na	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0	100.0
Ni	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0	100.0
P	<100	<100	<100	<100	<100	<100	<100	<100	<100	0	100.0
Pb	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	<0.100	0	100.0
Sr	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	0	100.0
Ti	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0	100.0
V	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0	100.0
Zn	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	0	100.0

Mineral Resource Program

Laboratory Report
U.S. Geological Survey
Lakewood,Colorado

USGS
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Job Number	Submitter	Contact	# of Samples	Entered by	Date Approved
MRP-02497	WILSON_S		37		

Lab No.	Field No.	Sample Description	Rep.	Test Comment	ICP_H2O Ag ug/L	ICP_H2O Al mg/L	ICP_H2O As ug/L	ICP_H B ug/L
C-170070	3Reag-H2O	Sierra reagent water	1		<10	<0.01	<100	<10
C-170071	5-LW-M	Blank lab H2O 14743 EV5197	1		<10	<0.01	<100	<10
C-170072	1-LW-M	McClelland labs HNO3	1		<10	<0.01	<100	<10
C-170073	6-LW-M	HNO3	1		<10	<0.01	<100	<10
C-170074	4-LW-M	--	1		<10	<0.01	<100	<10
C-170075	9-LW-M	NEL ICP/ICP-MS	1		<10	0.02	<100	<10
C-170076	2-Mli-H2O	ELI Millipore H2O	1		<10	<0.01	<100	<10
C-170077	Raw H2O	Energy Lab raw water	1		<10	<0.01	<100	<10
C-170078	8-LW-M	---	1		<10	<0.01	<100	<10
C-170079	3-USW-A	Sierra-0002-0641	1		<10	42	<100	78
C-170080	3-USW-B	Sierra-0002-0642	1		<10	33	<100	43
C-170081	3-NHR-A	Sierra-0002-0643	1		<10	0.043	220	300
C-170082	3-NHR-B	Sierra-0002-0644	1		<10	0.027	300	270
C-170083	5-NHR-AM	HNO3 preserved 14758 EV5197	1		<10	0.011	180	320
C-170084	5-NHR-BM	HNO3 preserved 14759 EV5197	1		<10	0.014	210	290
C-170085	5-USW-BM	HNO3 preserved 14755 EV5197	1		<10	50	<100	11
C-170086	5-USW-AM	HNO3 preserved 14754 EV5197	1		<10	45	<100	<10
C-170087	1-USW-AM	McClelland labs HNO3	1		<10	45	<100	98
C-170088	1-USW-BM	McClelland labs HNO3	1		<10	44	<100	100
C-170089	1-NHR-AM	McClelland labs HNO3	1		<10	0.22	240	290
C-170090	1-NHR-BM	McClelland labs HNO3	1		<10	0.2	250	320
C-170091	6-NHR-AM	HNO3	1		<10	0.087	230	310
C-170092	6-NHR-BM	HNO3	1		<10	0.25	220	280
C-170093	6-USW-AM	HNO3	1		<10	32	<100	<10
C-170094	6-USW-BM	HNO3	1		<10	30	<100	<10
C-170095	4-USW-AM	HNO3	1		<10	48	<100	85
C-170096	4-USW-BM	HNO3	1		<10	51	<100	86
C-170097	4-NHR-AM	HNO3	1		<10	0.13	230	400
C-170098	4-NHR-BM	HNO3	1		<10	0.097	230	370

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MRP-02497	WILSON_S		37		

Lab No.	Field No.	Sample Description	Rep.	Test Comment	ICP_H2O Ag ug/L	ICP_H2O Al mg/L	ICP_H2O As ug/L	ICP_H B ug/L
C-170099	9-19989	NEL ICP/ICP-MS	1		<10	0.011	<100	33
C-170100	9-22240	NEL ICP/ICP-MS	1		290	0.47	330	130
C-170101	9-22242	NEL ICP/ICP-MS	1		<10	<0.01	<100	260
C-170102	9-22469	NEL ICP/ICP-MS	1		<10	<0.01	<100	41
C-170103	2-USW-A	00-50999-1	1		<10	37	<100	<10
C-170104	2-USW-B	00-50999-2	1		<10	44	<100	<10
C-170105	2-NHR-A	00-50999-3	1		<10	0.1	290	360
C-170106	2-NHR-B	00-50999-4	1		<10	0.048	260	360

Mineral Resource Program

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Lab No.	Field No.	ICP_H2O Cd ug/L	ICP_H2O Co ug/L	ICP_H2O Cr ug/L	ICP_H2O Cu ug/L	ICP_H2O Fe mg/L	ICP_H2O K mg/L	ICP_H2O Li ug/L	ICP_H2O Mg mg/L	ICP_H2O Mn ug/L	ICP_H2O Mo ug/L	ICP_H2O Na mg/L	ICP Ni ug/L
C-170070	3Reag-H2O	<10	<10	<10	<10	<0.05	<0.1	<10	<0.1	<10	<20	<0.1	<10
C-170071	5-LW-M	<10	<10	<10	<10	<0.05	<0.1	<10	<0.1	<10	<20	<0.1	<10
C-170072	1-LW-M	<10	<10	<10	<10	<0.05	<0.1	<10	<0.1	<10	<20	<0.1	<10
C-170073	6-LW-M	<10	<10	<10	<10	<0.05	<0.1	<10	<0.1	<10	<20	<0.1	<10
C-170074	4-LW-M	<10	<10	<10	<10	<0.05	<0.1	<10	<0.1	<10	<20	<0.1	<10
C-170075	9-LW-M	<10	<10	<10	<10	<0.05	<0.1	<10	<0.1	<10	<20	<0.1	<10
C-170076	2-Mli-H2O	<10	<10	<10	<10	<0.05	<0.1	<10	<0.1	<10	<20	<0.1	<10
C-170077	Raw H2O	<10	<10	<10	<10	<0.05	<0.1	<10	<0.1	<10	<20	<0.1	<10
C-170078	8-LW-M	<10	<10	<10	<10	<0.05	<0.1	<10	<0.1	<10	<20	<0.1	<10
C-170079	3-USW-A	130	67	96	2400	36	5.1	90	18	4000	<20	6.3	240
C-170080	3-USW-B	100	43	71	1800	26	4.7	66	14	2900	<20	3.2	190
C-170081	3-NHR-A	<10	100	<10	<10	0.13	6.8	48	5.4	<10	46	130	<10
C-170082	3-NHR-B	<10	88	<10	<10	0.093	6	43	4.7	<10	41	120	<10
C-170083	5-NHR-AM	<10	110	<10	<10	0.11	7.2	53	6.3	<10	57	150	<10
C-170084	5-NHR-BM	<10	100	<10	<10	0.099	6.8	49	5.2	<10	51	140	<10
C-170085	5-USW-BM	150	65	110	2700	45	4.7	89	20	4400	<20	4.8	290
C-170086	5-USW-AM	140	70	93	2900	47	7.2	87	20	4200	<20	4.5	270
C-170087	1-USW-AM	140	60	100	2600	42	6.3	85	19	4000	<20	7	260
C-170088	1-USW-BM	130	62	98	2500	41	6.1	78	18	3900	<20	6.1	240
C-170089	1-NHR-AM	<10	86	<10	<10	0.21	6.8	44	4.9	66	44	120	<10
C-170090	1-NHR-BM	<10	95	<10	<10	0.19	6.8	47	5	19	49	130	<10
C-170091	6-NHR-AM	<10	130	<10	<10	0.17	7.4	54	6.6	<10	53	160	<10
C-170092	6-NHR-BM	<10	100	<10	<10	0.16	6.9	50	5.2	<10	49	140	<10
C-170093	6-USW-AM	100	41	60	1600	23	2	65	14	2900	<20	6.4	180
C-170094	6-USW-BM	110	47	54	1700	23	1.9	70	14	2900	<20	7.5	180
C-170095	4-USW-AM	140	65	110	2600	48	6.1	82	20	4200	<20	5.4	270
C-170096	4-USW-BM	150	72	120	2900	51	6.7	90	22	4500	<20	5.8	300
C-170097	4-NHR-AM	<10	110	<10	<10	0.19	7.8	54	5.9	<10	56	150	<10
C-170098	4-NHR-BM	<10	110	<10	<10	0.14	7.6	52	5.2	<10	55	140	<10

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Lab No.	Field No.	ICP_H2O Cd ug/L	ICP_H2O Co ug/L	ICP_H2O Cr ug/L	ICP_H2O Cu ug/L	ICP_H2O Fe mg/L	ICP_H2O K mg/L	ICP_H2O Li ug/L	ICP_H2O Mg mg/L	ICP_H2O Mn ug/L	ICP_H2O Mo ug/L	ICP_H2O Na mg/L	ICP Ni ug/l
C-170099	9-19989	<10	<10	<10	<10	<0.05	<0.1	470	<0.1	<10	<20	0.26	<10
C-170100	9-22240	180	660	630	880	0.54	0.49	<10	<0.1	500	<20	0.16	530
C-170101	9-22242	<10	<10	<10	<10	<0.05	0.2	<10	<0.1	<10	300	<0.1	<10
C-170102	9-22469	<10	<10	<10	<10	<0.05	25	<10	19	<10	25	45	<10
C-170103	2-USW-A	110	47	89	1800	32	4.3	67	15	3200	<20	3.2	210
C-170104	2-USW-B	130	59	110	2100	37	4.2	78	17	3700	<20	3.7	240
C-170105	2-NHR-A	<10	110	<10	<10	0.21	7.7	52	5.7	<10	57	140	<10
C-170106	2-NHR-B	<10	100	<10	<10	0.11	7.3	50	5.2	<10	62	140	<10

USGS
science for a changing world

Lab No.	Field No.	ICP_H2O Si mg/L	ICP_H2O Sr ug/L	ICP_H2O Ti ug/L	ICP_H2O V ug/L	ICP_H2O Zn ug/L
C-170070	3Reag-H2O	<0.1	<1	<50	<10	<10
C-170071	5-LW-M	<0.1	<1	<50	<10	<10
C-170072	1-LW-M	<0.1	<1	<50	<10	<10
C-170073	6-LW-M	<0.1	<1	<50	<10	<10
C-170074	4-LW-M	<0.1	<1	<50	<10	<10
C-170075	9-LW-M	<0.1	<1	<50	<10	<10
C-170076	2-Mli-H2O	<0.1	<1	<50	<10	<10
C-170077	Raw H2O	<0.1	<1	<50	<10	<10
C-170078	8-LW-M	<0.1	<1	<50	<10	<10
C-170079	3-USW-A	15	320	<50	14	22000
C-170080	3-USW-B	12	240	<50	11	16000
C-170081	3-NHR-A	8.3	560	<50	41	17
C-170082	3-NHR-B	7.9	510	<50	41	<10
C-170083	5-NHR-AM	7.5	660	<50	33	<10
C-170084	5-NHR-BM	7.2	550	<50	34	<10
C-170085	5-USW-BM	17	300	<50	25	25000
C-170086	5-USW-AM	14	320	<50	24	24000
C-170087	1-USW-AM	16	310	<50	20	23000
C-170088	1-USW-BM	16	280	<50	20	22000
C-170089	1-NHR-AM	8.7	500	<50	42	22
C-170090	1-NHR-BM	9.5	520	<50	47	14
C-170091	6-NHR-AM	7.9	680	<50	32	<10
C-170092	6-NHR-BM	8	520	<50	31	<10
C-170093	6-USW-AM	12	230	<50	<10	16000
C-170094	6-USW-BM	12	240	<50	<10	16000
C-170095	4-USW-AM	20	310	<50	22	25000
C-170096	4-USW-BM	21	340	<50	24	26000
C-170097	4-NHR-AM	8.9	640	<50	34	24
C-170098	4-NHR-BM	8.9	570	<50	33	<10

USGS
science for a changing world

Lab No.	Field No.	ICP_H2O Si mg/L	ICP_H2O Sr ug/L	ICP_H2O Ti ug/L	ICP_H2O V ug/L	ICP_H2O Zn ug/L
C-170099	9-19989	0.34	1.5	76	<10	<10
C-170100	9-22240	4.2	560	<50	820	650
C-170101	9-22242	<0.1	<1	<50	<10	<10
C-170102	9-22469	7.5	4.5	<50	<10	<10
C-170103	2-USW-A	17	240	<50	16	18000
C-170104	2-USW-B	19	270	<50	22	21000
C-170105	2-NHR-A	9.7	600	<50	50	30
C-170106	2-NHR-B	9.1	560	<50	44	<10

NEWMONT METALLURGICAL SERVICES
ASSAY RESULTS
January 15, 2001

DESCRIPTION	METHOD	ASSAY	RESULT	UNIT
CANMET KZK-1 0129	ANPA	DIGESTION	8.2	PH
	ANPA	ANPA CO2 F	2.73145	%
	ANPA	ANPA CACO3	62.1131	T/1000
	ANPA	DIGESTION	8.2	PH
	ANPA	ANPA CO2 F	2.74131	%
	ANPA	ANPA CACO3	62.3376	T/1000
	ANPA	DIGESTION	8.2	PH
	ANPA	ANPA CO2 F	2.71937	%
	ANPA	ANPA CACO3	61.8385	T/1000
	ANPA	DIGESTION	8.2	PH
	ANPA	ANPA CO2 F	2.71213	%
	ANPA	ANPA CACO3	61.6740	T/1000
	ANPA	DIGESTION	8.2	PH
	ANPA	ANPA CO2 F	2.73968	%
	ANPA	ANPA CACO3	62.3005	T/1000
	C/S ROAST	CAP FINAL	0.69714	%
	C/S ROAST	SAP FINAL	0.35382	%
	C/S ROAST	CAP FINAL	0.70011	%
	C/S ROAST	SAP FINAL	0.33538	%
	C/S ROAST	CAP FINAL	0.71980	%
	C/S ROAST	SAP FINAL	0.31841	%
	C/S ROAST	CAP FINAL	0.73337	%
	C/S ROAST	SAP FINAL	0.31779	%
	C/S ROAST	CAP FINAL	0.73818	%
	C/S ROAST	SAP FINAL	0.31239	%
	C/S TOTAL	CTOT FINAL	0.96	%
	C/S TOTAL	STOT FINAL	0.8331	%
	C/S TOTAL	CTOT FINAL	0.982	%
	C/S TOTAL	STOT FINAL	0.8292	%
	C/S TOTAL	CTOT FINAL	0.962	%
	C/S TOTAL	STOT FINAL	0.8331	%
	C/S TOTAL	CTOT FINAL	0.976	%
	C/S TOTAL	STOT FINAL	0.8338	%
	C/S TOTAL	CTOT FINAL	0.963	%
	C/S TOTAL	STOT FINAL	0.8316	%
	CAAS	CAAS FINAL	15800	PPM
	CAAS		1.58	%
	CAAS		14920	PPM
	CAAS		1.492	%
	CAAS		15320	PPM
	CAAS		1.532	%
	CAAS		16800	PPM
	CAAS		1.68	%
	CAAS		15720	PPM
	CAAS		1.572	%
	CAI	CAI FINAL	0.10078	%
	CAI		0.09177	%
	CAI		0.05566	%
	CAI		0.06692	%

NEWMONT METALLURGICAL SERVICES
ASSAY RESULTS
January 15, 2001

DESCRIPTION	METHOD	ASSAY	RESULT	UNIT
CANMET KZK-1 0129	CAI	CAI FINAL	0.06605	%
	SCIS	SCIS FINAL	0.76098	%
	SCIS		0.79330	%
	SCIS		0.72511	%
	SCIS		0.78123	%
	SCIS		0.78764	%
	SHCL	SHCL FINAL	0.46110	%
	SHCL		0.47038	%
	SHCL		0.49170	%
	SHCL		0.43155	%
	SHCL		0.50098	%
	SHNO3	SHNO3 FINA	1170	PPM
	SHNO3		0.11648	%
	SHNO3		1060	PPM
	SHNO3		0.10612	%
	SHNO3		640	PPM
	SHNO3		0.06351	%
	SHNO3		840	PPM
	SHNO3		0.08300	%
	SHNO3		880	PPM
	SHNO3		0.08824	%
CANMET NBM-1 1109	ANPA	DIGESTION	8.2	PH
	ANPA	ANPA CO2 F	2.56152	%
	ANPA	ANPA CACO3	58.2489	T/1000
	ANPA	DIGESTION	8.2	PH
	ANPA	ANPA CO2 F	2.61362	%
	ANPA	ANPA CACO3	59.4338	T/1000
	ANPA	DIGESTION	8.2	PH
	ANPA	ANPA CO2 F	2.55397	%
	ANPA	ANPA CACO3	58.0774	T/1000
	ANPA	DIGESTION	8.2	PH
	ANPA	ANPA CO2 F	2.56050	%
	ANPA	ANPA CACO3	58.2259	T/1000
	ANPA	DIGESTION	8.2	PH
	ANPA	ANPA CO2 F	2.58843	%
	ANPA	ANPA CACO3	58.8611	T/1000
	C/S ROAST	CAP FINAL	0.29123	%
	C/S ROAST	SAP FINAL	0.28032	%
	C/S ROAST	CAP FINAL	0.30975	%
	C/S ROAST	SAP FINAL	0.24300	%
	C/S ROAST	CAP FINAL	0.32821	%
	C/S ROAST	SAP FINAL	0.22486	%
	C/S ROAST	CAP FINAL	0.34713	%
	C/S ROAST	SAP FINAL	0.22008	%
	C/S ROAST	CAP FINAL	0.36456	%
	C/S ROAST	SAP FINAL	0.20745	%
	C/S TOTAL	CTOT FINAL	0.808	%
	C/S TOTAL	STOT FINAL	0.3282	%
	C/S TOTAL	CTOT FINAL	0.82	%

NEWMONT METALLURGICAL SERVICES
ASSAY RESULTS
January 15, 2001

DESCRIPTION	METHOD	ASSAY	RESULT	UNIT
CANMET NBM-1 1109	C/S TOTAL	STOT FINAL	0.317	%
	C/S TOTAL	CTOT FINAL	0.83	%
	C/S TOTAL	STOT FINAL	0.3289	%
	C/S TOTAL	CTOT FINAL	0.817	%
	C/S TOTAL	STOT FINAL	0.3206	%
	C/S TOTAL	CTOT FINAL	0.816	%
	C/S TOTAL	STOT FINAL	0.3293	%
	CAAS	CAAS FINAL	10400	PPM
	CAAS		1.04	%
	CAAS		11000	PPM
	CAAS		1.1	%
	CAAS		10600	PPM
	CAAS		1.06	%
	CAAS		10840	PPM
	CAAS		1.084	%
	CAAS		10480	PPM
	CAAS		1.048	%
	CAI	CAI FINAL	0.07489	%
	CAI		0.06818	%
	CAI		0.07434	%
	CAI		0.07297	%
	CAI		0.06772	%
	SCIS	SCIS FINAL	0.30217	%
	SCIS		0.29641	%
	SCIS		0.23130	%
	SCIS		0.23539	%
	SCIS		0.30709	%
	SHCL	SHCL FINAL	0.26331	%
	SHCL		0.28873	%
	SHCL		0.28911	%
	SHCL		0.27855	%
	SHCL		0.28358	%
	SHNO3	SHNO3 FINA	260	PPM
	SHNO3		0.02624	%
	SHNO3		350	PPM
	SHNO3		0.03491	%
	SHNO3		320	PPM
	SHNO3		0.03147	%
	SHNO3		380	PPM
	SHNO3		0.03787	%
	SHNO3		410	PPM
	SHNO3		0.04116	%
CANMET KZK-1 1318	CANMET	PASTE PH F	8.50	PH
	CANMET	NP-STD-SF	76.52	T/1000
	CANMET	NP-STD-MF	78.26	T/1000
	CANMET	NP-MOD-SF	62.03	T/1000
	CANMET	NP-MOD-MF	62.33	T/1000
	CANMET	BCR-IT FIN	6.16	KG/T
	CANMET	PASTE PH F	8.55	PH

NEWMONT METALLURGICAL SERVICES
ASSAY RESULTS
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DESCRIPTION	METHOD	ASSAY	RESULT	UNIT
CANMET KZK-1 1318	CANMET	NP-STD-SF	67.37	T/1000
	CANMET	NP-STD-MF	77.97	T/1000
	CANMET	NP-MOD-SF	59.75	T/1000
	CANMET	NP-MOD-MF	58.74	T/1000
	CANMET	BCR-IT FIN	7.35	KG/T
	CANMET	PASTE PH F	8.61	PH
	CANMET	NP-STD-SF	64.26	T/1000
	CANMET	NP-STD-MF	78.78	T/1000
	CANMET	NP-MOD-SF	57.17	T/1000
	CANMET	NP-MOD-MF	64.40	T/1000
	CANMET	BCR-IT FIN	6.89	KG/T
	CANMET	PASTE PH F	8.63	PH
	CANMET	NP-STD-SF	62.15	T/1000
	CANMET	NP-STD-MF	79.95	T/1000
	CANMET	NP-MOD-SF	55.58	T/1000
	CANMET	NP-MOD-MF	66.91	T/1000
	CANMET	BCR-IT FIN	5.17	KG/T
	CANMET	PASTE PH F	8.69	PH
	CANMET	NP-STD-SF	65.29	T/1000
	CANMET	NP-STD-MF	81.19	T/1000
	CANMET	NP-MOD-SF	59.66	T/1000
	CANMET	NP-MOD-MF	73.39	T/1000
	CANMET	BCR-IT FIN	5.88	KG/T
CANMET NBM-1 1112	CANMET	PASTE PH F	8.26	PH
	CANMET	NP-STD-SF	59.97	T/1000
	CANMET	NP-STD-MF	89.50	T/1000
	CANMET	NP-MOD-SF	63.76	T/1000
	CANMET	NP-MOD-MF	60.90	T/1000
	CANMET	BCR-IT FIN	11.20	KG/T
	CANMET	PASTE PH F	8.29	PH
	CANMET	NP-STD-SF	55.01	T/1000
	CANMET	NP-STD-MF	92.55	T/1000
	CANMET	NP-MOD-SF	74.92	T/1000
	CANMET	NP-MOD-MF	65.18	T/1000
	CANMET	BCR-IT FIN	16.81	KG/T
	CANMET	PASTE PH F	8.27	PH
	CANMET	NP-STD-SF	48.26	T/1000
	CANMET	NP-STD-MF	92.14	T/1000
	CANMET	NP-MOD-SF	76.83	T/1000
	CANMET	NP-MOD-MF	59.23	T/1000
	CANMET	BCR-IT FIN	18.43	KG/T
	CANMET	PASTE PH F	8.29	PH
	CANMET	NP-STD-SF	56.16	T/1000
	CANMET	NP-STD-MF	88.25	T/1000
	CANMET	NP-MOD-SF	77.10	T/1000
	CANMET	NP-MOD-MF	61.10	T/1000
	CANMET	BCR-IT FIN	21.07	KG/T
	CANMET	PASTE PH F	8.28	PH
	CANMET	NP-STD-SF	47.10	T/1000

NEWMONT METALLURGICAL SERVICES
ASSAY RESULTS
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DESCRIPTION	METHOD	ASSAY	RESULT	UNIT
CANMET NBM-1 1112	CANMET	NP-STD-MF	92.51	T/1000
	CANMET	NP-MOD-SF	81.93	T/1000
	CANMET	NP-MOD-MF	58.55	T/1000
	CANMET	BCR-IT FIN	24.07	KG/T
CONTROL RTS-1	ANPA	DIGESTION	8.2	PH
	ANPA	ANPA CO2 F	0.37587	%
	ANPA	ANPA CACO3	8.54733	T/1000
	C/S ROAST	CAP FINAL	0.03613	%
	C/S ROAST	SAP FINAL	1.67663	%
	C/S TOTAL	CTOT FINAL	0.119	%
	C/S TOTAL	STOT FINAL	1.7592	%
	CAAS	CAAS FINAL	11400	PPM
	CAAS		1.14	%
	CAI	CAI FINAL	0.15593	%
	CANMET	PASTE PH F	3.53	PH
	CANMET	NP-STD-SF	-1.20	T/1000
	CANMET	NP-STD-MF	5.18	T/1000
	CANMET	NP-MOD-SF	20.57	T/1000
	CANMET	NP-MOD-MF	-2.83	T/1000
	CANMET	BCR-IT FIN	2.47	KG/T
	SCIS	SCIS FINAL	0.18396	%
	SHCL	SHCL FINAL	0.53522	%
	SHNO3	SHNO3 FINA	1560	PPM
	SHNO3		0.15513	%

220 rows selected.

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M E M O R A N D U M

TO: C. Bucknam

File 10120
MI 4174

FROM: D. Brosnahan/Inverness

DATE: October 18, 2000

COPY: M. Dietrich/Inverness
K.M. LeVier/Inverness
J. Odekirk/Inverness

SUBJECT: XRD-XRF Analysis of Two CANMET Reference Standards

C. Bucknam submitted two samples of potential acid base accounting (ABA) reference material from CANMET for XRD-XRF analysis. The mineralogy of the samples as reported by CANMET accompanied the submittal.

Tables I and II attached show the XRD-XRF results. The mineral quantities (Table I) were determined by comparison of peak intensities with standard mineral curves, and adjusted to conform to the XRF chemistry (Table II). The mineralogy of sample KZK-1 generally agrees with the composition reported by CANMET. This includes quartz, muscovite, plagioclase, and ankerite. CANMET reported 1% biotite; no attempt was made to distinguish biotite from muscovite here. CANMET also reported 1.6% pyrite and 0.9% pyrrhotite ($Fe_{1-x}S$). Evidence for these sulfides did not appear in the XRD spectra, indicating concentrations below the 1% detectability limit by XRD. This is consistent with the 0.38% S found by XRF (Table II).

The XRD pattern for sample NBM-1 showed a sharp 7Å reflection along with a diffuse peak representing 14Å. This agrees with the chlorite reported by CANMET, but a peak at the 4.8 Å position of chlorite was missing. To confirm chlorite, a clay-water suspension was evaporated onto a glass slide, resulting in orientation of the sheet-silicate minerals for enhanced XRD resolution. Treating the slide with ethylene glycol caused the 14Å inter-layer distance to swell to 17Å, confirming the presence of montmorillonite, or possibly some other smectite clay, rather than chlorite. The 7Å peak

remained unaffected, confirming kaolinite. Therefore, the NBM-1 sheet silicates differ significantly from those reported. In addition to the high clay contents found here (10% kaolinite and 2% montmorillonite vs. 1.3% chlorite reported by CANMET), XRD also indicated more mica (13% biotite here vs. 3.6%).

Chalcopyrite was observed while examining washed NBM-1 material with a stereomicroscope. The CANMET mineralogy shows 0.6% chalcopyrite, in agreement with the 0.28% Cu found by XRF, which yields 0.8% chalcopyrite by calculation. Converting the sulfur value (0.19%) to chalcopyrite yields 0.5%. CANMET also reports trace quantities of pyrite and bornite (Cu_5FeS_4).

Table I
Approximate Mineral Concentrations in CANMET Reference Standards - (%)*

SAMPLE	QTZ	PLG	KFL	MUSC	BIOT	ANK	SID	KAO	MONT	HEMA	RUTL
KZK-1	35	16	0	40	0	8	0	0	0	0	1
NBM-1	30	40	3	0	13	0	1	10	2	1	0

*QTZ	quartz	SiO_2
PLG	plagioclase	$(Ca,Na)(Al,Si)AlSi_2O_8$
KFL	K-Feldspar	$KAlSi_3O_8$
MUSC	muscovite	$KAl_2(AlSi_3O_{10})(OH)_2$
BIOT	biotite	$K(Mg,Fe)_3(AlSi_3O_{10})(OH)_2$
ANK	ankerite	$Ca(Fe,Mg)(CO_3)_2$
SID	siderite	$FeCO_3$
KAO	kaolinite	$Al_2Si_2O_5(OH)_4$
MONT	montmorillonite	$(½Ca,Na)_{0.35}(Al,Mg,Fe)_2(Si,Al)_4O_{10}(OH)_2 \cdot nH_2O$
HEMA	hematite	Fe_2O_3
RUTL	rutile	TiO_2

Table II
Semiquantitative X-Ray Fluorescence Analysis of CANMET Reference Standards

SAMPLE	SIO2	AL2O3	FE	MGO	CAO	NA2O	K2O	TIO2	P2O5	S	MNO	BA	CU	MO	PB	SB	ZN	AS
KZK-1	67.91	11.08	3.23	1.42	2.69	1.14	4.79	0.60	0.09	0.38	0.07	0.28	0.00	0.00	0.00	0.00	0.03	0.03
NBM-1	64.44	12.07	3.96	2.90	3.27	3.54	2.94	0.68	0.17	0.19	0.01	0.09	0.28	0.00	0.00	0.00	0.01	0.03

SIO2 Silica
AL2O3 Alumina
FE Iron
MGO Magnesium Oxide
CAO Calcium Oxide
NA2O Sodium Oxide

K2O Potassium Oxide
TIO2 Titanium Oxide
P2O5 Phosphate
S Sulfur
MNO Manganese Oxide
BA Barium

CU Copper
MO Molybdenum
PB Lead
SB Antimony
ZN Zinc
AS Arsenic