Whole-Rock Geochemical Data for the Payson Lakes and Santaquin Quadrangles, Juab and Utah Counties, Utah

by

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INTRODUCTION

This Open-File Report makes available data from laboratory analyses completed to determine the chemical composition of igneous rock samples collected during geologic mapping funded or supported by the U.S. Geological Survey (USGS) National Cooperative Geologic Mapping Program and the Utah Geological Survey (UGS) (see McKean and others, 2020, 2021). The samples were prepared by ALS USA Inc., (Reno, Nevada, and North Vancouver, British Columbia) with analyses performed under contract to the UGS (see table 1). See appendix for the analytical methods. These data are technical in nature and proper interpretation requires training in applicable geochemical techniques.

The analytical data can be accessed electronically as an Excel document attached to the PDF file of this report and available at https://ugspub.nr.utah.gov/publications/open_file_reports/ofr-742/ofr-742.xlsx.

DISCLAIMER

This open-file release is intended as a data repository for technical analytical information gathered in support of geologic mapping of the Payson Lakes and Santaquin quadrangles. These data may not conform to UGS technical or editorial standards. Therefore, it may be premature for an individual or group to take actions based on the contents of this report. The Utah Department of Natural Resources, Utah Geological Survey, makes no warranty, expressed or implied, regarding its suitability for a particular use. The Utah Department of Natural Resources, Utah Geological Survey, shall not be liable under any circumstances for any direct, indirect, special, incidental, or consequential damages with respect to claims by users of this product.

The views and conclusions contained in this document are those of the author and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Government.

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REFERENCES

LeBas, M.J., Le Maitre, R.W., Steckeisen, A.L., and Zanettin, B., 1986, A chemical classification of volcanic rocks based on the total alkali-silica diagram: Journal of Petrology, v. 27, part 3, p. 745–750.

McKean, A.P., Harris, R.H., and Hiscock, A.I., 2021, Provisional geologic map of the Payson Lakes quadrangle, Utah County, Utah: unpublished Utah Geological Survey contract deliverable map prepared for U.S. Geological Survey, USGS STATEMAP award no. G20AC00244, 41 p., 1 plate, scale 1:24,000.

McKean, A.P., Solomon, B.J., Harris, R.H., Kirby, S.M., and Hiscock, A.I., 2020, Interim geologic map of the Santaquin quadrangle, Utah and Juab Counties, Utah: unpublished Utah Geological Survey contract deliverable map prepared for U.S. Geological Survey, USGS STATEMAP award no. G19AC00228, 45 p., 1 plate, scale 1:24,000.

Table 1. *Major- and trace-element whole-rock analyses from the Payson Lakes and Santaquin quadrangles, Juab and Utah Counties, Utah.*

Sample Number	Map Unit	Unit Name	Rock Type	Rock Name	Map Reference	UTM easting	UTM northing	Latitude (°N)	Longitude (°W)	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	Na_2O	K_2O	Cr_2O_3	TiO_2	MnO	P_2O_5	SrO	BaO	LOI	Total
PL2021-282	Tt	Tuff of Payson Canyon	ash-flow tuff	andesite	McKean and others, 2021	440736	4427591	39.99642	-111.69425	46.17	9.08	1.41	18.65	0.73	1.4	2.6	<0.01	0.19	0.04	0.06	0.03	0.08	18.2	98.64
PL2021-440	Tt	Tuff of Payson Canyon	ash-flow tuff	rhyolite	McKean and others, 2021	440787	4424755	39.97088	-111.69339	67.46	13.18	2.39	1.97	0.98	1.95	3.99	<0.01	0.29	0.05	0.077	0.04	0.11	6.19	98.68
PL2021-521	Tr	Tuff of Red Lake	welded tuff	dacite	McKean and others, 2021	439623	4422003	39.94600	-111.70677	65.44	14.66	5.77	4.1	0.66	2.9	2.95	<0.01	0.72	0.1	0.372	0.05	0.11	1.83	99.66
PL2021-524	Tr	Tuff of Red Lake	welded tuff	latite	McKean and others, 2021	439609	4421957	39.94559	-111.70692	59.66	16.97	6.35	5.8	1.72	3.47	3.27	<0.01	0.85	0.11	0.35	0.06	0.11	1.59	100.3
PL2021-547	Tt	Tuff of Payson Canyon	ash-flow tuff	dacite	McKean and others, 2021	440910	4424179	39.96570	-111.69190	60.73	14.8	4.06	4.17	1.97	2.12	2.13	<0.01	0.5	0.03	0.132	0.07	0.11	8.45	99.27
PL2021-563	Tt	Tuff of Payson Canyon	ash-flow tuff	dacite	McKean and others, 2021	440647	4423541	39.95993	-111.69492	60.54	12.54	3.06	7.06	1.12	1.81	3.17	<0.01	0.39	0.07	0.11	0.05	0.1	8.73	98.75
PL2021-931	Tvc	Volcanic conglomerate	clast	latite	McKean and others, 2021	446316	4419726	39.92594	-111.62823	55.06	17.27	8.14	6.17	2.49	2.89	3.17	<0.01	1.02	0.14	0.45	0.07	0.17	1.92	98.96
PL2021-932	Tvc	Volcanic conglomerate	clast	latite	McKean and others, 2021	446311	4419783	39.92645	-111.62830	56.5	17.66	8.39	6.18	2.43	3.09	3.15	<0.01	1.05	0.15	0.459	0.08	0.18	0.87	100.2
PL2021-941	Tvc	Volcanic conglomerate	clast	latite	McKean and others, 2021	439624	4418027	39.91018	-111.70638	55.74	17.18	8.06	6.27	2.47	2.78	3.22	<0.01	1.04	0.15	0.448	0.08	0.17	1.74	99.35
PL2021-942	Tvc	Volcanic conglomerate	clast	andesite	McKean and others, 2021	439629	4418033	39.91024	-111.70633	55.44	16.98	7.67	6.24	2.57	2.51	3.06	<0.01	1.03	0.15	0.448	0.07	0.17	2.57	98.91
PL2021-943	Tvc	Volcanic conglomerate	clast	andesite	McKean and others, 2021	439118	4418480	39.91422	-111.71235	56.45	17.09	7.81	6.2	2.6	2.82	3.09	<0.01	0.95	0.15	0.446	0.08	0.15	1.79	99.63
PL2021-944	Tvc	Volcanic conglomerate	clast	dacite	McKean and others, 2021	439108	4418514	39.91453	-111.71247	62.04	16.58	5.57	4.91	1.16	3.49	3.3	<0.01	0.62	0.06	0.39	0.07	0.14	1.32	99.65
SQ2020-711	Tvc	Volcanic conglomerate member of the volcanic rocks of Goshen Canyon	clast	latite	McKean and others, 2020	427716	4422698	39.95133	-111.84621	58.98	17.24	6.86	5.78	1.22	3.33	3.15	<0.01	0.93	0.07	0.462	0.08	0.19	1.82	100.1
SQ2020-712	Tvc	Volcanic conglomerate member of the volcanic rocks of Goshen Canyon	clast	andesite	McKean and others, 2020	427726	4422702	39.95137	-111.84610	57.46	17.13	6.54	5.98	2.31	2.77	3.22	<0.01	0.93	0.13	0.454	0.08	0.18	2.75	99.93
SQ2020-750	Tvc	Volcanic conglomerate member of the volcanic rocks of Goshen Canyon	clast	dacite	McKean and others, 2020	427890	4422721	39.95155	-111.84418	62.73	16.97	3.87	4.31	1	3.12	3.8	<0.01	0.51	0.1	0.263	0.07	0.18	3.02	99.94
SQ2020-751	Tvc	Volcanic conglomerate member of the volcanic rocks of Goshen Canyon	clast	andesite	McKean and others, 2020	427950	4423170	39.95560	-111.84353	57.81	17.38	5.77	6.36	2.3	2.99	2.97	<0.01	0.88	0.15	0.424	0.08	0.18	2.63	99.92
SQ2020-752	Tvc	Volcanic conglomerate member of the volcanic rocks of Goshen Canyon	clast	andesite	McKean and others, 2020	427947	4423170	39.95560	-111.84356	57.14	17.2	6.68	5.83	2.17	2.93	3.05	<0.01	0.87	0.14	0.449	0.08	0.19	3.19	99.92
SQ2020-801	Tt	Rhyolite tuff	tuff	dacite	McKean and others, 2020	427840	4423962	39.96273	-111.84489	58.32	13.67	4.65	5.49	1.48	1.65	2	0.01	0.76	0.04	0.147	0.06	0.12	11.3	99.7
SQ2020-1199	Tt	Rhyolite tuff	tuff	rhyolite	McKean and others, 2020	429202	4422264	39.94755	-111.82877	67.3	13.82	2.26	2.09	1.13	2.22	3.52	<0.01	0.3	0.04	0.077	0.04	0.12	6.78	99.7

Notes:

Rock name using total alkali-silica diagram of LeBas and others (1986), for values normalized to 100% based on a volatile free basis, using LOI, data not shown here.
Location data based on NAD83.
Major oxides reported in weight percent and trace elements reported in parts per million (ppm).
LOI is loss on ignition at 1000ºC.

Analysis Source:

Analyses by ALS USA Inc., North Vancouver, British Columbia, Canada; major oxides results from x-ray fluorescence (XRF), trace elements by inductively coupled plasma-mass spectrometry (ICP-MS), and 4 acid dissolution ICP for base metals (marked with an *).

Table 1. *Continued.*

Sample Number	Ag*	As*	Cd*	Co*	Cu*	Li*	Mo*	Ni*	Pb*	Sc*	Tl*	Zn*	Ba	Ce	Cr	Cs	Dy	Er	Eu	Ga	Gd	Hf	Ho	La	Lu	Nb	Nd	Pr	Rb	Sm	Sn	Sr	Ta	Tb	Th	Tm	U	V	W	Y	Yb	Zr
PL2021-282	<0.5	<5	<0.5	3	11	30	1	7	20	6	<10	41	696	83.1	20	6.15	4.31	2.63	1.09	13	4.78	3.5	0.79	48.9	0.37	13.3	37.4	9.93	87.1	5.76	1	237	0.9	0.68	14.1	0.34	2.27	19	1	22.6	2.68	115
PL2021-440	<0.5	<5	<0.5	3	12	30	1	6	26	6	<10	54	1090	129.5	20	5.52	4.37	2.67	1.6	19.4	5.85	5.9	0.85	69.3	0.39	20.3	50.3	14.25	133.5	7.54	2	354	1.3	0.79	22.9	0.27	3.41	27	3	24.1	2.32	182
PL2021-521	<0.5	6	<0.5	11	7	10	<1	3	20	10	<10	47	949	65.5	10	1	4.22	2.66	1.37	18.5	4.98	4.1	0.8	33.6	0.33	9.9	30.7	7.92	69.5	4.96	2	416	0.7	0.66	10.5	0.32	3.42	58	2	23.5	2.28	152
PL2021-524	<0.5	<5	<0.5	17	8	20	1	2	19	11	<10	83	989	76.1	10	3.11	4.4	2.38	1.51	21.6	5.75	5.1	0.78	38.2	0.35	11.7	34.9	8.91	96.1	6.23	2	502	0.8	0.68	12.35	0.31	3.59	118	2	22.2	2.18	183
PL2021-547	<0.5	<5	<0.5	9	7	20	1	6	21	8	<10	51	975	110.5	20	4.29	4.34	2.32	1.43	20.7	5.32	7.4	0.8	58.3	0.32	18.5	43.5	11.9	80.6	7.06	2	535	1.2	0.69	21	0.29	3.08	68	2	19.7	2.03	264
PL2021-563	<0.5	<5	<0.5	5	7	20	1	6	22	6	<10	43	833	102	20	4.32	4.29	2.68	1.35	17.4	5	6.7	0.85	55.6	0.41	16.9	38.8	10.95	112	5.72	2	433	1.1	0.68	19.6	0.36	4.72	46	3	25.4	2.72	244
PL2021-931	<0.5	<5	<0.5	18	12	10	1	5	17	14	<10	118	1460	74.6	10	2.41	5.19	2.86	1.88	24.1	6.92	7.3	0.96	38.3	0.4	12.1	38.3	9.2	74.7	7.37	1	621	0.6	0.94	7.36	0.34	1.67	134	1	27.4	2.45	285
PL2021-932	<0.5	<5	<0.5	17	9	10	<1	2	18	13	<10	126	1555	75.6	10	1.94	5.7	3.22	2.11	24.1	6.78	7.2	1.04	37.8	0.4	12.8	38.6	9.34	65	6.72	1	627	0.6	0.86	6.85	0.37	1.46	123	1	27.8	2.77	279
PL2021-941	<0.5	<5	<0.5	17	9	10	1	2	16	15	<10	131	1490	75.7	10	2.28	5.96	3.1	2.05	24.3	6.84	7	1.07	37.2	0.44	12.9	37.9	9.39	75.9	7.54	2	626	0.7	0.91	6.87	0.4	1.54	127	1	28.5	2.87	281
PL2021-942	<0.5	<5	<0.5	16	10	10	<1	4	16	15	<10	124	1380	71.2	<10	2.02	5.32	3.35	2.05	22.3	6.81	6.8	0.96	34.7	0.41	12	36.5	8.56	68.9	7.27	1	581	0.6	0.92	6.31	0.37	1.45	125	1	26.8	2.74	262
PL2021-943	<0.5	<5	<0.5	15	6	10	1	1	18	14	<10	125	1325	81.5	<10	2.4	5.97	3.37	2.3	23	7.36	7.2	1.12	40.2	0.46	12.8	41.9	10.15	74.1	8.29	2	622	0.6	1.02	7.47	0.43	1.54	87	1	29.5	2.84	278
PL2021-944	<0.5	<5	<0.5	6	2	20	<1	3	18	8	<10	88	1250	96.3	<10	2.37	5.66	2.82	2.22	23.1	7.67	7.4	1.08	67.7	0.33	13.9	57.9	14.9	89.6	9.72	2	606	0.7	1.02	10.1	0.4	2.14	47	1	27.6	2.53	279
SQ2020-711	<0.5	12	<0.5	11	7	20	1	2	18	13	<10	124	1680	88.8	10	3.14	6.06	3.25	2.09	22.4	6.71	8.5	1.09	45.3	0.44	14	41.2	10.8	74.4	7.88	2	688	0.7	0.92	7.4	0.47	1.72	105	2	29.3	3.13	356
SQ2020-712	<0.5	<5	0.5	12	6	10	1	1	17	13	<10	146	1595	90	<10	2.41	5.88	3.28	2.22	22.6	6.6	8.5	1.14	45.7	0.49	14.2	42	10.65	82.5	7.96	2	689	0.8	0.96	7.64	0.51	1.64	90	1	30.7	2.8	361
SQ2020-750	<0.5	6	<0.5	6	6	10	2	3	31	6	<10	100	1780	98.8	10	3.16	5.18	3.27	1.9	21.8	5.87	8.1	1.02	50.5	0.5	15.4	42.9	11.55	119	7.94	2	606	0.7	0.84	10.4	0.46	2.31	28	2	29.9	3.25	328
SQ2020-751	<0.5	<5	0.9	13	7	10	1	<1	26	13	<10	111	1720	88.2	10	2.59	5.48	3.13	1.99	22.1	6.16	7.7	1.12	44.1	0.4	13.3	41.1	10.5	98.6	7.61	2	698	0.5	0.91	7.59	0.48	1.82	99	2	30	2.96	317
SQ2020-752	<0.5	6	<0.5	12	9	10	<1	2	18	12	<10	108	1760	88.9	<10	2.34	5.64	3.09	2.07	22.3	6.64	8.4	1.11	44.7	0.53	13.7	41.4	10.85	104	8.18	2	677	0.6	0.92	7.46	0.5	1.48	76	1	31.9	3.26	352
SQ2020-801	<0.5	<5	<0.5	9	9	20	1	15	29	14	<10	69	1145	112.5	70	3.15	4.78	2.68	1.52	20.2	5.7	9.2	0.94	56.8	0.38	17.8	43.7	12.5	89.9	7.76	2	500	0.9	0.78	15.7	0.43	3.79	119	2	25.7	2.72	558
SQ2020-1199	<0.5	7	<0.5	3	5	40	1	6	31	6	10	55	1115	139	20	5.51	4.66	2.61	1.55	19.4	5.71	5.9	0.87	73.4	0.38	21.4	51.5	14.8	128	8.32	2	379	1.2	0.78	22.1	0.4	3.4	36	2	24.6	2.77	193

Appendix

ANLYTICAL METHODS

Sample Preparation Package

PREP-31
Standard Sample Preparation: Dry, Crush, Split and Pulverize

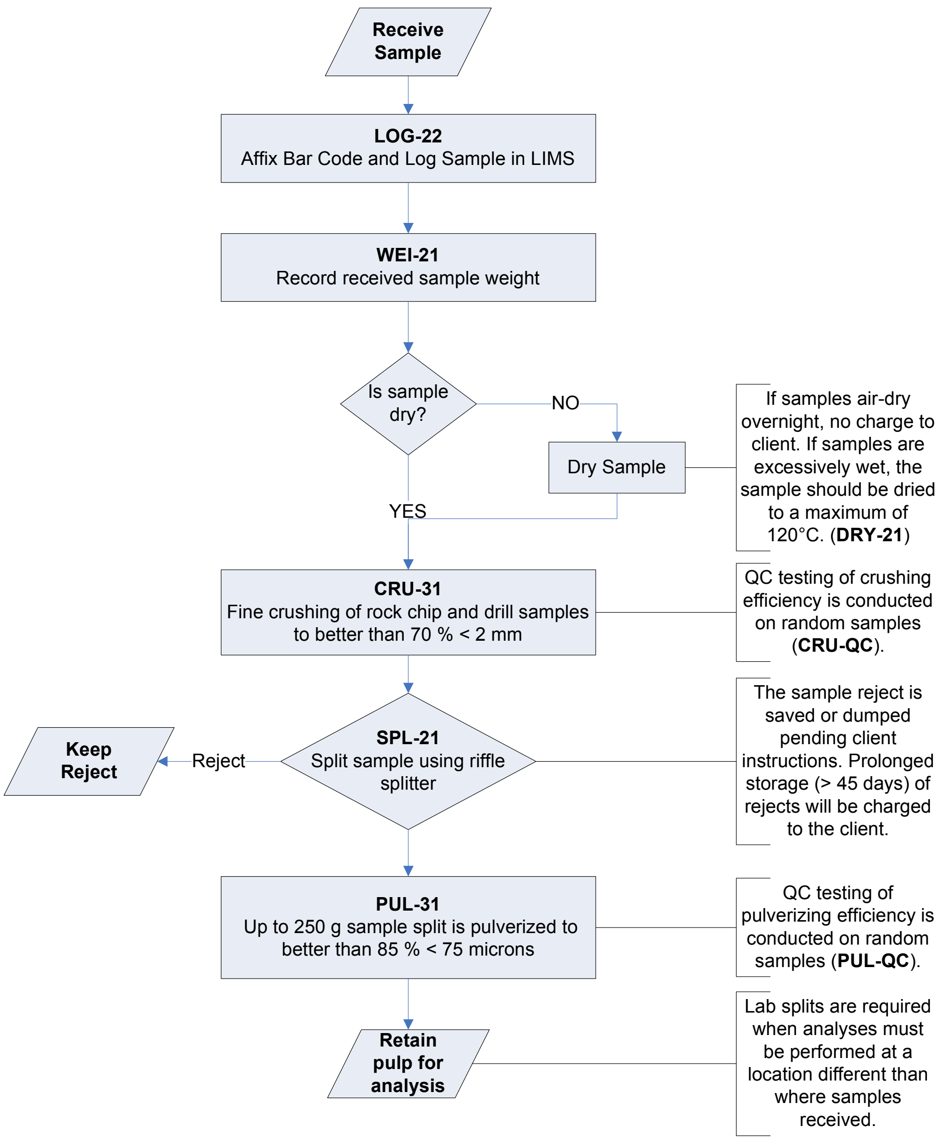
Sample preparation is the most critical step in the entire laboratory operation. The purpose of preparation is to produce a homogeneous analytical sub-sample that is fully representative of the material submitted to the laboratory.

The sample is logged in the tracking system, weighed, dried and finely crushed to better than 70 % passing a 2 mm (Tyler 9 mesh, US Std. No.10) screen. A split of up to 250 g is taken and pulverized to better than 85 % passing a 75 micron (Tyler 200 mesh, US Std. No. 200) screen. This method is appropriate for rock chip or drill samples.

Method Code	Description
LOG-22	Sample is logged in tracking system and a bar code label is attached.
CRU-31	Fine crushing of rock chip and drill samples to better than 70 % of the sample passing 2 mm.
SPL-21	Split sample using riffle splitter.
PUL-31	A sample split of up to 250 g is pulverized to better than 85 % of the sample passing 75 microns.

Sample Preparation Package

Flow Chart - Sample Preparation Package – PREP-31
Standard Sample Preparation: Dry, Crush, Split and Pulverize



Assay Procedure

OA-GRA06
LOI for Whole Rock Geochemistry

Analytical Method:

Gravimetric

OA-GRA06:

A 3g sample is weighed into a ceramic crucible and put into a furnace at 1000ºC. After cooling, the sample is weighed again and the difference in weights is used to calculate the loss on ignition (LOI) at 1000ºC. The prepared, ashed sample is then fused with lithium borate flux to create a glass disc for analysis by ME-XRF06.

Analyte	Symbol	Units	Lower Limit	Upper Limit
Loss on Ignition	LOI	%	0.01	100

NOTE: Negative LOI values may be attributed to oxidation of samples during the LOI process. For example, FeO may oxidize to Fe_2O_3 and result in weight gain.

ALS Chemex

Whole Rock Geochemistry – ME-XRF06

Sample Decomposition: 50% $Li_2B_4O_7$ – 50% $LiBO_2$ (WEI-GRA06)
Analytical Method: X-Ray Fluorescence Spectroscopy (XRF)

A calcined or ignited sample (0.9 g) is added to 9.0g of Lithium Borate Flux (50 % - 50 % $Li_2B_4O_7$ – $LiBO_2$), mixed well and fused in an auto fluxer between 1050 - 1100°C. A flat molten glass disc is prepared from the resulting melt. This disc is then analysed by X-ray fluorescence spectrometry.

Element	Symbol	Units	Lower Limit	Upper Limit
Aluminum Oxide	Al_2O_3	%	0.01	100
Barium Oxide	BaO	%	0.01	100
Calcium Oxide	CaO	%	0.01	100
Chromium Oxide	Cr_2O_3	%	0.01	100
Ferric Oxide	Fe_2O_3	%	0.01	100
Potassium Oxide	K_2O	%	0.01	100
Magnesium Oxide	MgO	%	0.01	100
Manganese Oxide	MnO	%	0.01	100
Sodium Oxide	Na_2O	%	0.01	100
Phosphorus Oxide	P_2O_5	%	0.01	100
Silicon Oxide	SiO_2	%	0.01	100
Strontium Oxide	SrO	%	0.01	100

ALS Chemex

Element	Symbol	Units	Lower Limit	Upper Limit
Titanium Oxide	TiO_2	%	0.01	100
Loss On Ignition	LOI	%	0.01	100
	Total	%	0.01	101

Note: Since samples that are high in sulphides or base metals can damage Platinum crucibles, a ME-ICP06 finish method can be selected as an alternative method.

Geochemical Procedure

ME-MS81
Ultra-Trace Level Methods

Sample Decomposition:

Lithium Metaborate Fusion (FUS-LI01)

Analytical Method:

Inductively Coupled Plasma - Mass Spectroscopy (ICP - MS)

A prepared sample (0.200 g) is added to lithium metaborate flux (0.90 g), mixed well and fused in a furnace at 1000°C. The resulting melt is then cooled and dissolved in 100 mL of 4% HNO_3 / 2% HCl solution. This solution is then analyzed by inductively coupled plasma - mass spectrometry.

Element	Symbol	Units	Lower Limit	Upper Limit
Barium	Ba	ppm	0.5	10000
Cerium	Ce	ppm	0.5	10000
Cobalt*	Co	ppm	0.5	10000
Chromium	Cr	ppm	10	10000
Cesium	Cs	ppm	0.01	10000
Dysprosium	Dy	ppm	0.05	1000
Erbium	Er	ppm	0.03	1000
Europium	Eu	ppm	0.03	1000
Gallium	Ga	ppm	0.1	1000
Gadolinium	Gd	ppm	0.05	1000
Hafnium	Hf	ppm	0.2	10000
Holmium	Ho	ppm	0.01	1000
Lanthanum	La	ppm	0.5	10000
Lutetium	Lu	ppm	0.01	1000

ALS

Geochemical Procedure

Element	Symbol	Units	Lower Limit	Upper Limit
Molybdenum*	Mo	ppm	2	10000
Niobium	Nb	ppm	0.2	2500
Neodymium	Nd	ppm	0.1	10000
Praseodymium	Pr	ppm	0.03	1000
Rubidium	Rb	ppm	0.2	10000
Samarium	Sm	ppm	0.03	1000
Tin	Sn	ppm	1	10000
Strontium	Sr	ppm	0.1	10000
Tantalum	Ta	ppm	0.1	2500
Terbium	Tb	ppm	0.01	1000
Thorium	Th	ppm	0.05	1000
Thallium	Tl	ppm	0.5	1000
Thulium	Tm	ppm	0.01	1000
Uranium	U	ppm	0.05	1000
Vanadium	V	ppm	5	10000
Tungsten	W	ppm	1	10000
Yttrium	Y	ppm	0.5	10000
Ytterbium	Yb	ppm	0.03	1000
Zirconium	Zr	ppm	2	10000

***Note**: Some base metal oxides and sulfides may not be completely decomposed by the lithium borate fusion. Results for Co and Mo will not likely be quantitative by this method.

Geochemical Procedure

Adding Base Metals – ME-AQ81, ME-4ACD81

Sample Decomposition: Aqua Regia (GEO-AR01) or 4-acid (GEO-4ACID)
Analytical Method: Inductively Coupled Plasma – Atomic Emission spectroscopy (ICP - AES)

The lithium metaborate fusion is not the preferred method for the determination of base metals. Many sulfides and some metal oxides are only partially decomposed by the borate fusion and some elements such as cadmium and zinc can be volatilized.

Base metals can be reported with ME-MS81 for either an aqua regia digestion (**ME-AQ81**) or a four acid digestion (**ME-4ACD81**). The four acid digestion is preferred when the targets include more resistive mineralization such as that associated with nickel and cobalt.

Element	Symbol	Units	Lower Limit	Upper Limit
Silver	Ag	ppm	0.5	100
Arsenic	As	ppm	5	10000
Cadmium	Cd	ppm	0.5	10000
Cobalt	Co	ppm	1	10000
Copper	Cu	ppm	1	10000
Mercury**	Hg	ppm	1	10000
Molybdenum	Mo	ppm	1	10000
Nickel	Ni	ppm	1	10000
Lead	Pb	ppm	1	10000
Zinc	Zn	ppm	2	10000

**Hg is only offered with the aqua regia digestion.