

Division of Geological & Geophysical Surveys

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**MAJOR-OXIDE, MINOR-OXIDE, AND TRACE-ELEMENT
GEOCHEMICAL DATA FROM ROCKS COLLECTED IN THE
LIVENGOOD QUADRANGLE, ALASKA IN 2001 AND 2003**

by

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Note: This report (including all analytical data, tables, and map sheets) is available in digital format from the ADGGS web site (<http://www.dggs.dnr.state.ak.us>) at no charge. The digital data are available as PDF files and Excel spreadsheets.

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INTRODUCTION

Mineral resource personnel from the Alaska Division of Geological and Geophysical Surveys carried out a geological field survey, including mapping and sampling in the Livengood quadrangle, Alaska from May 28 through June 16, 2003. The fieldwork provides basic information critical to building an understanding of Alaska's geology and is part of the Alaska Airborne Geophysical/Geological Mineral Inventory Program, an integrated program of airborne geophysical surveys followed by geological mapping. Alaska Airborne Geophysical/Geological Mineral Inventory Program is a special multi-year investment by the State of Alaska to expand Alaska's geologic and mineral resources knowledge base, catalyze future private-sector mineral exploration and development, and guide state planning. The geologic mapping is also funded in part by the U.S. Geological Survey STATEMAP program.

During 2001, 6 rock samples were collected for geochemical trace-element analysis. During 2003, 54 rock samples were collected for geochemical trace-element analysis and 50 samples were collected for whole-rock (major- and minor-oxides and petrogenetically important trace-element data) analysis. Visibly mineralized samples and samples with features that may indicate potential mineralization are preferentially selected for trace-element analysis. The locations of these samples are shown on Sheet 1, Maps A (whole-rock geochemistry) and B (trace-element geochemistry). Location data (in UTM coordinates based on the Clarke 1866 spheroid, NAD27 datum, UTM zone 6 projection), descriptions, and analytical results for each sample are tabulated in Tables 1 through 4.

ANALYTICAL METHODS

All whole-rock analyses (Table 1) and trace-element geochemistry (Table 3) were performed by ALS Chemex in 2003. Rock samples were crushed so that 70% of the material passed through a -10 (2 mm) mesh screen. Rock samples were then pulverized so that 85% of the material passed through a -200 (75 μm) mesh screen. Riffle splitters ensured accurate sampling of 30-gram and 200-gram samples.

Major and minor oxides were determined by X-ray fluorescence spectrometry (XRF) following a lithium metaborate fusion. Petrogenetically important trace elements (Ba, Nb, Sr, Y, and Zr) were also analyzed using XRF methods on a pressed powder pellet. Analytical detection limits for these data are tabulated in Table 5.

Gold was analyzed on a 30-gram split using either Fire Assay - Atomic Absorption Spectroscopy (FA-AAS, Au1) or Inductively Coupled Plasma - Mass Spectroscopy (ICP-MS, Au2) methods following Fire Assay Fusion. One sample was re-analyzed for gold with a gravimetric finish following Fire Assay Fusion (FA- Gravimetric, Au3). Platinum and palladium were analyzed by the Inductively Coupled Plasma - Mass Spectroscopy (ICP-MS) method following Fire Assay Fusion. Trace elements were analyzed by the Inductively Coupled Plasma - Atomic Emission Spectroscopy (ICP-AES) methods following acid digestion (HF - HNO₃ - HClO₄ and HCl leach). Arsenic >1% was re-analyzed by Atomic Absorption Spectroscopy (AAS) after aqua regia digestion. Mercury was analyzed by Cold Vapor Atomic Absorption Spectroscopy. Trace-element detection limits are tabulated in Table 6.

Table 1. Concentrations of major oxides, minor oxides, and trace elements in rock samples collected in the Livengood Quadrangle.
 Note: --- = not analyzed.

SAMPLE	Al2O3 %	BaO %	CaO %	Cr2O3 %	Fe2O3 %	K2O %	MgO %	MnO %	Na2O %	P2O5 %	SiO2 %	SrO %	TiO2 %	LOI %	Total %	Ba ppm	Rb ppm	Sr ppm	Nb ppm	Zr ppm	Y ppm
2003JEA3B	15.66	0.04	8.75	0.03	12.22	0.29	6.90	0.13	2.86	0.31	48.37	0.04	1.91	2.46	99.96	330	5	319	18	131	26
2003JEA29A	15.18	0.02	8.04	0.02	11.23	0.23	6.96	0.18	4.20	0.09	50.50	0.03	0.78	2.49	99.96	200	8	259	3	55	22
2003JEA42A	16.59	0.04	4.25	0.01	12.66	0.41	5.71	0.13	3.49	0.44	48.83	0.02	3.29	4.10	99.98	240	4	364	17	187	23
2003JEA68A	0.19	0.03	25.07	0.01	0.59	0.02	13.35	0.12	0.01	0.09	23.54	0.01	0.09	36.80	99.92	---	---	---	---	---	---
2003JEA76A	17.93	0.04	9.06	<0.01	11.58	0.24	3.86	0.11	4.25	0.45	46.27	0.06	1.98	3.51	99.34	370	4	554	29	200	30
2003JEA90A	8.32	0.05	3.00	0.04	5.86	1.35	2.89	0.11	0.11	0.09	69.99	0.02	0.42	6.65	98.90	530	38	132	6	90	21
2003JEA234A	14.58	0.38	3.65	<0.01	4.00	6.09	1.40	0.09	3.29	0.32	58.97	0.11	0.43	5.64	98.94	3300	183	991	21	372	24
2003JEA235A	18.29	0.22	1.43	<0.01	9.49	5.08	1.40	0.24	4.06	0.10	51.27	0.02	1.17	6.88	99.65	1860	125	135	57	464	54
2003JEA236A	13.31	0.14	0.58	0.01	5.49	3.81	1.72	0.07	0.06	0.05	66.97	0.02	0.51	6.14	98.88	1410	140	92	70	874	81
2003JEA237B	14.56	0.21	1.45	<0.01	6.58	4.30	1.33	0.14	0.55	0.09	64.70	0.03	0.77	5.22	99.92	1950	138	141	36	359	50
2003JEA237C	12.75	0.05	0.84	<0.01	5.55	1.06	0.29	0.01	5.52	0.06	68.80	0.03	0.61	4.20	99.79	490	23	128	37	452	61
2003JEA238A	14.50	0.13	0.17	<0.01	6.22	3.90	0.89	0.08	1.34	0.04	65.72	0.02	0.56	4.70	98.28	1280	171	42	71	794	91
2003JEA238B	13.93	0.12	0.29	0.01	6.26	3.73	1.03	0.15	1.00	0.04	66.40	0.01	0.51	4.95	98.44	1200	168	33	74	945	110
2003JEA239B	12.49	0.04	0.35	<0.01	2.88	0.89	0.38	0.02	5.51	0.07	73.68	0.01	0.60	1.74	98.67	330	20	76	84	2160	280
2003JEA241A	19.37	0.22	0.18	<0.01	2.07	7.64	0.33	<0.01	2.73	0.09	62.64	0.02	1.18	2.49	98.95	1980	221	141	65	883	100
2003JEA243A	14.13	0.26	4.01	<0.01	5.78	1.12	2.12	0.08	4.76	0.37	59.63	0.15	0.53	5.82	98.76	2240	44	1400	12	372	26
2003JEA301A	16.60	0.48	0.33	<0.01	3.46	7.89	0.30	<0.01	2.93	0.39	62.36	0.10	0.62	3.03	98.50	3760	223	921	22	415	21
2003JEA310A	16.73	0.02	0.30	<0.01	1.01	1.94	0.19	<0.01	6.34	0.03	70.10	0.04	0.23	1.53	98.45	170	112	359	27	499	20
2003MBW3A	15.85	0.02	6.96	<0.01	11.31	0.24	4.29	0.13	4.92	0.16	52.18	0.04	1.14	2.20	99.42	100	4	336	<2	97	30
2003MBW9B	15.76	0.35	1.04	0.02	4.11	7.27	3.32	0.05	1.94	0.15	61.35	0.11	0.63	3.23	99.32	2800	249	995	15	256	16
2003MBW11A	15.77	0.01	6.32	<0.01	10.71	0.26	5.17	0.12	4.90	0.11	53.11	0.03	0.89	1.82	99.22	100	8	245	<2	64	22
2003MBW15A	0.07	0.01	29.66	<0.01	0.04	0.01	19.64	<0.01	0.11	0.04	6.30	0.01	<0.01	43.70	99.58	---	---	---	---	---	---
2003MBW42A	22.90	0.01	14.21	0.01	4.69	0.30	6.38	0.05	2.18	0.03	45.87	0.02	0.31	2.89	99.86	20	4	155	2	12	9
2003MBW53A	13.80	0.01	12.38	0.01	8.85	0.07	4.64	0.22	1.20	0.14	52.22	0.03	0.69	5.15	99.41	40	2	215	<2	78	27
2003MBW87.2A	17.66	0.09	2.97	<0.01	13.84	0.28	4.18	0.17	5.02	0.93	49.25	0.04	1.92	2.67	99.00	740	3	260	55	671	82
2003MBW112A	12.84	0.01	17.13	0.15	4.98	0.42	10.37	0.14	1.56	0.02	47.06	0.01	0.31	3.35	98.34	100	8	76	<2	4	11
2003MBW120A	16.60	0.21	1.75	<0.01	9.75	3.62	1.83	0.35	4.21	0.14	53.31	0.01	1.12	5.16	98.06	1990	93	134	45	267	44
2003MBW240A	0.15	0.02	32.52	0.01	0.14	0.02	17.97	0.01	<0.01	0.11	2.06	0.01	0.08	45.00	98.10	---	---	---	---	---	---
2003MBW249B	16.34	0.19	2.82	<0.01	9.82	3.14	2.39	0.27	4.19	0.13	53.40	0.02	1.09	4.76	98.56	1750	84	136	36	244	39
2003MBW258A	16.33	0.17	3.01	<0.01	9.84	2.97	2.39	0.27	4.14	0.13	53.35	0.02	1.07	4.78	98.48	1650	79	133	36	237	43
2003RN53A	15.35	0.05	6.41	<0.01	17.11	0.64	6.44	0.16	2.92	0.60	41.96	0.05	3.89	4.46	100.05	290	9	427	27	265	33
2003RN121A	15.79	0.31	0.66	0.01	4.92	6.73	2.96	0.02	2.04	0.27	62.36	0.09	0.58	2.58	99.34	2550	247	827	15	254	21
2003RN130A	15.55	0.01	8.89	0.01	9.47	0.22	5.46	0.11	3.60	0.10	52.51	0.01	0.71	2.24	98.89	100	3	54	<2	52	19

Table 1. Concentrations of major oxides, minor oxides, and trace elements in rock samples collected in the Livengood Quadrangle.
 Note: --- = not analyzed.

SAMPLE	Al2O3	BaO	CaO	Cr2O3	Fe2O3	K2O	MgO	MnO	Na2O	P2O5	SiO2	SrO	TiO2	LOI	Total	Ba	Rb	Sr	Nb	Zr	Y
2003RN209A	15.61	0.02	11.82	0.04	9.83	2.20	7.81	0.20	1.23	0.06	44.94	0.01	0.81	4.92	99.51	110	28	28	<2	44	23
2003RN209A	15.61	0.02	11.82	0.04	9.83	2.20	7.81	0.20	1.23	0.06	44.94	0.01	0.81	4.92	99.51	110	28	28	<2	44	23
2003Z211C	15.91	0.48	1.93	<0.01	7.93	10.59	2.23	0.09	0.59	0.61	55.20	0.12	0.84	2.73	99.24	3820	341	1035	21	389	17
2003Z212A	15.22	0.06	5.94	0.01	16.49	0.56	6.91	0.19	2.71	0.54	42.59	0.02	3.89	3.77	98.92	520	7	423	25	257	34
2003Z217A	0.24	0.02	53.10	<0.01	0.29	0.01	1.95	0.02	0.02	0.07	0.85	0.02	0.09	43.10	99.78	---	---	---	---	---	---
2003Z218A	16.45	0.04	6.42	0.01	13.19	0.27	7.60	0.16	3.21	0.38	44.49	0.02	2.17	4.84	99.25	320	4	311	23	189	30
2003Z135A	0.06	0.02	26.84	<0.01	0.16	0.01	14.61	0.01	0.02	0.01	20.07	0.01	0.07	36.50	98.39	---	---	---	---	---	---
2003Z142A	14.10	0.08	6.27	<0.01	14.09	0.80	4.30	0.22	3.32	0.24	49.67	0.02	2.71	3.30	99.12	660	18	259	14	143	32
2003Z149B	15.23	0.02	7.77	0.04	8.11	1.48	8.06	0.27	3.55	0.07	50.41	0.02	0.72	3.70	99.43	130	22	98	<2	36	19
2003Z175B	14.31	0.02	19.28	0.01	12.86	0.08	6.96	0.27	0.18	0.09	39.83	0.01	0.93	4.70	99.54	70	2	12	2	52	20
2003Z175C	15.34	0.03	16.86	0.03	11.70	0.05	10.26	0.27	0.14	0.37	35.14	0.01	3.57	5.97	99.75	150	2	30	4	102	26
2003Z185A	13.89	0.03	10.51	0.02	13.06	0.16	6.57	0.16	3.05	0.14	46.80	0.01	1.84	3.68	99.92	150	5	36	<2	102	40
2003Z32A	9.39	0.04	0.27	0.01	4.55	1.80	1.15	0.06	1.07	0.08	78.21	0.01	0.53	2.68	99.86	390	71	47	10	86	12
2003Z239A	14.68	0.18	0.17	<0.01	2.54	4.03	0.44	<0.01	1.00	0.04	73.20	0.01	0.54	2.40	99.22	1790	177	55	83	784	102
2003Z255A	15.78	0.02	8.47	<0.01	11.39	0.28	4.68	0.14	4.20	0.09	52.50	0.05	0.74	1.27	99.59	190	8	218	<2	45	19
2003Z60A	14.96	0.04	8.18	0.04	15.66	0.77	7.16	0.13	2.47	0.29	38.27	0.03	2.20	8.11	98.32	350	9	285	12	154	26
2003Z74A	0.14	0.02	13.83	0.01	0.59	0.04	9.32	0.01	0.06	0.06	53.14	<0.01	0.09	21.30	98.61	---	---	---	---	---	---
2003Z78A	16.12	0.05	5.16	0.01	14.20	0.44	5.89	0.15	3.22	0.49	44.60	0.02	3.23	6.12	99.70	400	10	338	22	220	30

Table 2. Location and description of rock samples collected for major-oxide, minor-oxide, and trace-element analyses in the Livengood Quadrangle.

SAMPLE	UTM E	UTM N	DESCRIPTION
2003JEA3B	432274	7271250	Basalt; massive.
2003JEA29A	431621	7266629	Gabbro; green, very fine grained.
2003JEA42A	430722	7268544	Greenstone; massive.
2003JEA68A	423346	7267935	Siliceous dolomite.
2003JEA76A	421683	7265267	Basalt; amygdaloidal, red-brown weathering.
2003JEA90A	431450	7267738	Greenstone.
2003JEA234A	427625	7265475	Syenite porphyry; 20% feldspar phenocrysts \approx 1 cm long, 2% quartz phenocrysts < 0.4 cm in diameter; tan, fine grained matrix.
2003JEA235A	428443	7266477	Quartz monzonite; blue gray, feldspar porphyry (10% phenocrysts, 1 cm long), 15-20% mafic minerals altered to iron oxide and clay.
2003JEA236A	428443	7266477	Granite; light gray to white, flow banded, feldspar 1-2 mm long, 20% quartz phenocrysts, 5% disseminated pyrite.
2003JEA237B	428443	7266477	Granite porphyry; propylitic alteration, amygdules 2 mm in diameter filled with quartz and minor iron oxide and carbonate, feldspar phenocrysts 0.4 cm long.
2003JEA237C	428443	7266477	Porphyry; gray, feldspar and quartz phenocrysts, pyrite disseminated and in veins cutting phenocrysts.
2003JEA238A	429812	7266506	Granite; gray, foliated, porphyritic feldspar 3 mm long, xenoliths of more igneous rock, arsenopyrite and pyrite disseminated and in veins with quartz (2 mm wide).
2003JEA238B	429812	7266506	Granite; dark gray-black, porphyritic feldspar 2 mm long.
2003JEA239B	429812	7266506	Granite; gray-green, porphyritic feldspar.
2003JEA241A	429020	7266650	Plutonic; gray-green, 2% feldspar phenocrysts \approx 3 mm long.
2003JEA243A	429400	7266500	Plutonic dike; light gray, fine grained (2-3 mm), equigranular, highly sericite altered, disseminated pyrite and arsenopyrite \approx 3 mm in size.
2003JEA301A	430132	7266081	Monzonite/syenite; cream, sericite altered, feldspar \approx 1 cm long, biotite.
2003JEA310A	430106	7266096	Granite; white, fine-medium grained, few porphyritic K-feldspar \leq 1 cm long, xenolith of sedimentary (?) material.
2003MBW3A	428230	7266930	Gabbro; dark gray, fine grained, equigranular, homogeneous, massive, 60% plagioclase, 40% clinopyroxene and hornblende.
2003MBW9B	430052	7266066	Quartz monzonite dike; light-medium gray, feldspar (\leq 1.5 cm long) and biotite porphyritic, texture varies.
2003MBW11A	429065	7265013	Gabbro; gray-green, equigranular, 1-2 mm grains, 50% plagioclase, 50% mafics, minor quartz-carbonate veins.
2003MBW15A	421633	7265354	Siliceous dolomite; high silica content, very fine grained, very weak reaction to HCl.
2003MBW42A	433811	7265236	Gabbro; white and green, medium grained, equigranular, 60-70% plagioclase, 30-40% mafics.
2003MBW53A	434228	7266908	Greenstone; dark green, very fine grained.
2003MBW87.2A	433587	7268358	Greenstone; forest green, aphanitic, highly magnetic.
2003MBW112A	432727	7266592	Gabbro; medium green, fine-medium grained, equigranular, layered, 50% plagioclase, 50% mafics. Cut by numerous quartz + epidote (?) veins 4 mm wide.
2003MBW120A	434931	7266137	Mafic volcanic conglomerate/breccia greenstone; medium green, angular-subrounded clasts, range of clast sizes from < 1 mm to 7.5 cm.
2003MBW240A	433908	7268177	Dolomite; pale tan, aphanitic, slowly effervescing, locally cut by quartz veins.
2003MBW249B	428840	7267312	Syenite; dark green, fine grained, equigranular.

Table 2. Location and description of rock samples collected for major-oxide, minor-oxide, and trace-element analyses in the Livengood Quadrangle.

SAMPLE	UTM E	UTM N	DESCRIPTION
2003MBW258A	429127	7266588	Quartz syenite; porphyritic.
2003RN53A	431130	7268846	Greenstone; very dark green, very fine grained.
2003RN121A	430070	7265879	Quartz syenite; medium grained, 25% biotite and 75% feldspar phenocrysts, few porphyritic feldspar 1 cm long.
2003RN130A	431660	7265410	Greenstone; medium-pale green, massive.
2003RN209A	441636	7265377	Greenstone; gray-green, massive, conglomeratic texture (1-2 cm clasts, subrounded, clast-supported).
2003Z32A	433023	7275793	Siliceous siltstone; pale to olive green, blocky to platy breaking.
2003Z60A	423239	7266166	Greenstone; granular texture, blocky breaking.
2003Z74A	429742	7267713	Siliceous dolomite; light tan to gray, high silica content, popcorn weathering surface.
2003Z78A	429498	7268163	Greenstone; dark green to black, granular, massive to blocky. Carbonate veinlets 1-3 mm wide.
2003Z135A	430458	7272193	Siliceous limestone; dark gray and white, silica as veins and weblike throughout rock.
2003Z142A	419355	7278817	Hornblende diorite; green, medium grained (2-3 mm), 60% plagioclase, 10% hornblende.
2003Z149B	438713	7265890	Biotite hornblende gabbro; pale to medium green, coarse grained, mostly equigranular, biotite as clots.
2003Z175B	440367	7265896	Intermediate volcanic; pale to gray green, fine grained, sucratic texture.
2003Z175C	440367	7265896	Intermediate volcanic; pale green and white, fine grained, platy breaking.
2003Z185A	441101	7265636	Mafic volcanic? olive green to green-black, very fine grained, trace pyrite.
2003Z211C	429098	7268767	Syenite dike; dark gray, biotite porphyritic.
2003Z212A	429024	7268667	Greenstone; amygdaloidal to microgabbroic to diabasic texture.
2003Z217A	428268	7270526	Limestone; dark gray, fine-medium grained, strong reaction to HCl, some vuggy webwork of calcite veinlets (< 1 mm wide veinlets, some sparry grains).
2003Z218A	428304	7270489	Greenstone; amygdaloidal (carbonate-filled), massive, somewhat granular.
2003Z239A	429297	7266656	Granite; dark gray to black, porphyritic feldspar 1-2 mm long, iron oxide stained.
2003Z255A	427758	7266231	Gabbro; black and white, fine grained, 1% disseminated pyrite and trace chalcopyrite (?).

Table 3. Concentration of trace elements in rock samples collected in the Livengood Quadrangle.

Note: --- = not analyzed.

SAMPLE	Au1 ppm	Au2 ppm	Au3 ppm	Pt ppm	Pd ppm	Ag ppm	Al %	As1 ppm	As2 %	Ba ppm	Be ppm	Bi ppm	Ca %	Cd ppm	Co ppm	Cr ppm	Cu ppm	Fe %	Hg ppm	K %
2001MBW449A	0.046	---	---	---	---	<0.5	6.27	182	---	490	0.8	<2	0.05	<0.5	1	24	6	0.80	0.03	0.30
2001MBW450A	0.306	---	---	---	---	0.5	6.82	309	---	350	1.7	<2	0.04	0.5	<1	19	9	1.78	0.05	2.47
2001MBW456A	0.228	---	---	---	---	<0.5	7.84	2640	---	850	2.8	<2	0.03	<0.5	<1	12	9	1.23	0.05	1.28
2001MBW456B	0.145	---	---	---	---	<0.5	0.46	1955	---	40	<0.5	<2	9.29	<0.5	45	1260	28	3.04	0.01	0.08
2001MBW457A	0.676	---	---	---	---	1.9	7.57	>10000	2.44	80	5.3	<2	0.33	0.9	4	36	24	4.71	3.90	2.34
2001MBW458A	>10.0	---	34.7	---	---	9.2	0.81	>10000	26.4	10	0.8	32	1.52	16.8	36	300	57	19.10	0.31	0.31
2003JEA36A	0.009	---	---	---	---	<0.5	6.66	54	---	60	0.5	<2	4.10	<0.5	43	94	50	8.51	---	0.06
2003JEA131A	<0.005	---	---	---	---	<0.5	0.59	65	---	120	0.7	2	0.21	10.7	84	102	472	8.04	---	0.09
2003JEA137A	<0.005	---	---	---	---	<0.5	0.44	<5	---	190	<0.5	<2	0.01	<0.5	1	136	9	0.42	---	0.08
2003JEA144A	<0.005	---	---	---	---	<0.5	0.50	<5	---	50	<0.5	<2	0.01	<0.5	3	83	25	0.74	---	0.03
2003JEA208A	---	0.007	---	0.0010	0.004	<0.5	8.47	5	---	100	<0.5	<2	6.25	<0.5	44	156	48	7.34	---	0.04
2003JEA256A	0.023	---	---	---	---	<0.5	1.37	466	---	140	0.5	<2	0.01	<0.5	1	106	114	3.92	0.16	0.51
2003JEA259A	---	0.102	---	0.0032	0.001	<0.5	0.45	413	---	50	<0.5	<2	0.06	<0.5	60	1045	10	3.75	0.17	0.03
2003JEA263A	<0.005	---	---	---	---	<0.5	0.78	14	---	320	<0.5	2	0.21	<0.5	4	99	23	1.10	---	0.11
2003JEA264A	<0.005	---	---	---	---	<0.5	0.11	6	---	130	<0.5	2	0.09	<0.5	2	82	12	0.21	---	0.02
2003MBW5C	4.01	---	---	---	---	<0.5	0.49	>10000	16.4	50	0.5	2	0.21	6.5	11	84	402	11.95	0.12	0.21
2003MBW7A	0.017	---	---	---	---	<0.5	0.85	90	---	90	<0.5	<2	0.01	<0.5	2	81	10	0.42	0.02	0.35
2003MBW9A	2.16	---	---	---	---	<0.5	7.64	>10000	6.15	230	5.6	<2	0.04	<0.5	4	34	222	3.98	0.08	0.58
2003MBW18C	0.007	---	---	---	---	<0.5	1.00	311	---	1020	0.7	<2	0.04	6.4	14	128	164	15.40	---	0.26
2003MBW31A	0.029	---	---	---	---	0.6	0.96	320	---	3010	<0.5	<2	0.06	2.6	9	164	381	11.50	0.12	0.18
2003MBW64A	0.005	---	---	---	---	<0.5	0.51	180	---	60	<0.5	<2	0.04	<0.5	4	152	20	0.80	---	0.04
2003MBW65A	<0.005	---	---	---	---	<0.5	0.34	72	---	80	<0.5	<2	0.09	<0.5	5	132	12	0.45	---	0.05
2003MBW66A	<0.005	---	---	---	---	<0.5	0.06	10	---	40	<0.5	<2	11.70	<0.5	1	32	5	0.12	---	0.01
2003MBW74A	---	0.013	---	0.0069	0.01	<0.5	8.52	<5	---	340	<0.5	<2	6.06	<0.5	33	35	162	8.95	0.01	0.17
2003MBW79A	0.029	---	---	---	---	<0.5	1.32	154	---	160	<0.5	<2	0.05	<0.5	6	132	37	4.00	0.12	0.59
2003MBW107B	0.446	---	---	---	---	<0.5	0.16	30	---	30	<0.5	<2	0.01	<0.5	1	112	18	0.36	0.02	0.04
2003MBW109A	0.023	---	---	---	---	<0.5	1.45	239	---	70	2.0	<2	0.02	<0.5	2	120	84	3.35	0.05	0.37
2003MBW109D	0.369	---	---	---	---	1.7	7.94	3070	---	540	1.4	<2	0.10	1.0	4	15	75	3.67	0.94	0.06
2003MBW110A	1.500	---	---	---	---	<0.5	7.13	>10000	6.97	4440	2.0	<2	0.07	0.5	1	19	333	5.11	0.02	3.97
2003MBW178B	<0.005	---	---	---	---	<0.5	1.90	343	---	190	1.4	<2	0.01	0.7	22	128	132	6.79	---	0.66
2003MBW246A	---	0.001	---	0.0043	0.004	<0.5	0.46	12	---	10	<0.5	<2	1.30	<0.5	89	1230	19	4.62	---	0.01
2003MBW251A	0.068	---	---	---	---	<0.5	6.49	221	---	570	1.0	<2	0.03	<0.5	1	55	25	0.99	0.06	0.93
2003MBW255A	0.481	---	---	---	---	<0.5	5.72	4520	---	160	1.8	<2	0.02	<0.5	1	52	32	3.40	0.05	2.55
2003MBW256A(1)	0.553	---	---	---	---	<0.5	6.36	3320	---	200	7.7	<2	0.03	1.6	1	36	27	2.93	0.02	2.97
2003MBW256A(2)	1.060	---	---	---	---	<0.5	7.66	805	---	410	2.4	<2	0.09	<0.5	<1	36	4	1.30	0.04	2.34
2003MBW259A	<0.005	---	---	---	---	<0.5	6.99	95	---	540	4.6	<2	0.01	<0.5	<1	17	6	2.93	---	3.89
2003MBW261A	<0.005	---	---	---	---	<0.5	6.06	39	---	1030	6.1	<2	0.02	<0.5	<1	35	9	5.77	---	2.80
2003MBW262A	0.036	---	---	---	---	<0.5	8.04	1335	---	1240	1.4	<2	0.03	<0.5	1	37	8	2.26	0.06	3.69
2003MBW267A	0.014	---	---	---	---	<0.5	8.32	664	---	2170	2.2	<2	0.01	<0.5	<1	34	4	0.79	0.03	5.39
2003MBW269A	0.196	---	---	---	---	0.7	7.52	4340	---	450	0.8	<2	0.01	<0.5	<1	46	13	2.17	0.16	0.13

Table 3. Concentration of trace elements in rock samples collected in the Livengood Quadrangle.

Note: --- = not analyzed.

SAMPLE	Mg %	Mn ppm	Mo ppm	Na %	Ni ppm	P ppm	Pb ppm	S %	Sb ppm	Sr ppm	Ti %	V ppm	W ppm	Zn ppm
2001MBW449A	0.02	31	11	4.52	4	420	24	0.20	21	257	0.27	2	<10	9
2001MBW450A	0.07	25	3	3.33	3	260	35	0.60	31	286	0.17	5	<10	27
2001MBW456A	0.07	36	3	4.35	2	680	20	0.25	37	94	0.27	11	10	18
2001MBW456B	6.90	1000	<1	0.08	1055	30	6	0.44	14	608	0.01	13	<10	249
2001MBW457A	0.24	48	<1	3.41	30	1170	16	1.70	95	1005	0.23	134	40	70
2001MBW458A	1.01	265	6	0.03	219	300	2800	6.60	461	505	0.01	24	50	93
2003JEA36A	3.28	1455	<1	3.00	64	670	3	0.11	8	194	1.03	370	<10	110
2003JEA131A	0.05	6400	5	0.01	124	5230	<2	0.01	8	19	0.01	101	<10	648
2003JEA137A	0.02	56	1	0.02	6	80	<2	<0.01	<5	12	0.02	5	<10	6
2003JEA144A	0.03	98	4	0.01	8	140	<2	<0.01	<5	3	0.01	14	<10	10
2003JEA208A	5.24	1265	4	3.06	96	340	3	0.06	8	56	0.65	279	<10	60
2003JEA256A	0.14	45	8	0.01	15	530	3	0.01	8	11	0.04	44	<10	75
2003JEA259A	12.30	593	2	0.01	1225	50	<2	0.04	114	25	0.01	28	<10	53
2003JEA263A	0.08	154	1	0.04	18	1020	3	<0.01	<5	21	0.04	59	<10	19
2003JEA264A	0.02	18	4	<0.01	7	200	<2	<0.01	<5	11	<0.01	10	<10	6
2003MBW5C	0.05	392	6	0.01	7	480	17	3.65	201	294	0.01	58	<10	56
2003MBW7A	0.07	34	<1	0.01	6	50	2	0.01	<5	8	0.03	24	<10	7
2003MBW9A	0.05	84	13	4.65	3	2280	12	0.85	39	461	0.16	110	50	33
2003MBW18C	0.19	312	13	0.06	180	4210	<2	0.01	47	23	0.04	59	<10	783
2003MBW31A	0.06	699	9	0.02	102	5890	4	0.06	13	49	0.05	241	<10	516
2003MBW64A	0.05	41	5	0.01	54	160	<2	<0.01	<5	5	0.05	23	<10	17
2003MBW65A	0.02	130	3	0.01	20	80	2	<0.01	<5	5	0.03	12	<10	10
2003MBW66A	2.23	58	<1	<0.01	4	110	<2	<0.01	<5	79	<0.01	2	<10	4
2003MBW74A	2.92	1575	<1	4.01	24	410	2	0.01	<5	442	0.47	359	<10	100
2003MBW79A	0.13	170	6	0.01	31	840	7	0.01	8	5	0.05	201	<10	160
2003MBW107B	0.01	21	4	<0.01	6	70	<2	<0.01	<5	19	0.01	9	<10	6
2003MBW109A	0.10	60	5	0.01	25	680	<2	0.01	17	6	0.05	92	<10	218
2003MBW109D	0.02	193	2	0.01	5	870	16	<0.01	8	53	0.32	97	30	28
2003MBW110A	0.07	55	<1	0.16	3	1840	4	0.04	5	469	0.11	107	10	41
2003MBW178B	0.11	2270	5	0.02	48	1060	<2	<0.01	6	45	0.06	39	<10	112
2003MBW246A	>15.0	743	<1	0.01	1830	<10	<2	<0.01	5	26	0.01	27	<10	44
2003MBW251A	0.03	23	1	4.12	4	160	28	0.34	29	103	0.20	3	<10	20
2003MBW255A	0.04	42	4	2.64	4	440	54	1.63	19	424	0.10	6	<10	24
2003MBW256A(1)	0.24	37	<1	0.49	3	140	31	2.37	365	72	0.17	3	<10	41
2003MBW256A(2)	0.08	37	3	3.42	2	330	22	1.06	58	172	0.23	3	<10	8
2003MBW259A	0.65	18	28	0.04	1	150	23	1.06	21	31	0.09	13	<10	19
2003MBW261A	0.23	37	2	0.92	3	120	30	0.20	24	49	0.16	6	<10	150
2003MBW262A	0.03	9	2	3.97	1	530	45	0.86	45	140	0.27	3	<10	18
2003MBW267A	0.07	13	<1	2.39	3	160	29	0.26	21	91	0.27	1	<10	13
2003MBW269A	0.01	42	4	6.32	3	520	265	0.44	129	416	0.28	12	<10	76

Table 3. Concentration of trace elements in rock samples collected in the Livengood Quadrangle.

Note: --- = not analyzed.

SAMPLE	Au1	Au2	Au3	Pt	Pd	Ag	Al	As1	As2	Ba	Be	Bi	Ca	Cd	Co	Cr	Cu	Fe	Hg	K
2003MBW279D	0.007	---	---	---	---	<0.5	1.64	65	---	110	<0.5	<2	0.43	<0.5	3	108	6	0.95	---	0.16
2003RN113A	0.010	---	---	---	---	<0.5	0.76	82	---	60	0.5	<2	0.01	<0.5	1	178	52	3.64	0.25	0.33
2003RN149A	0.006	---	---	---	---	<0.5	0.83	50	---	390	1.3	2	0.01	1.0	163	154	184	4.70	---	0.27
2003RN196A	<0.005	---	---	---	---	<0.5	0.81	56	---	160	<0.5	<2	0.01	<0.5	7	160	15	1.42	---	0.30
2003Z34A	0.020	---	---	---	---	<0.5	3.34	244	---	2430	1.1	<2	0.13	0.8	8	116	133	6.43	0.26	1.18
2003Z70C	0.017	---	---	---	---	<0.5	0.68	62	---	190	<0.5	<2	0.01	0.5	3	192	87	4.16	0.32	0.23
2003Z73A	---	0.003	---	0.0071	0.006	<0.5	0.28	6	---	20	<0.5	<2	0.17	<0.5	75	1300	16	4.50	---	<0.01
2003Z87A	---	0.001	---	0.0046	0.004	<0.5	0.46	7	---	30	<0.5	<2	0.38	<0.5	85	1430	15	4.81	---	0.01
2003Z91A	---	0.003	---	0.0052	0.005	<0.5	0.62	79	---	30	<0.5	<2	17.80	<0.5	75	1215	16	4.96	---	0.02
2003Z109B	0.007	---	---	---	---	<0.5	1.32	38	---	4920	0.8	<2	0.04	<0.5	1	138	22	3.54	---	0.28
2003Z157B	<0.005	---	---	---	---	<0.5	0.73	17	---	180	<0.5	<2	<0.01	<0.5	<1	110	28	2.12	---	0.27
2003Z161B	<0.005	---	---	---	---	<0.5	0.79	33	---	100	0.5	<2	0.01	<0.5	1	155	73	3.43	---	0.28
2003Z167B	<0.005	---	---	---	---	<0.5	0.58	8	---	160	<0.5	<2	0.01	<0.5	2	187	17	1.24	---	0.18
2003Z178B	0.005	---	---	---	---	<0.5	7.01	<5	---	20	<0.5	<2	15.45	<0.5	28	49	265	7.58	---	0.01
2003Z198A	0.010	---	---	---	---	<0.5	0.89	27	---	6550	0.5	<2	0.07	0.5	1	178	122	2.38	0.06	0.15
2003Z214B	0.006	---	---	---	---	<0.5	0.04	295	---	50	<0.5	<2	0.18	<0.5	1	130	5	4.71	---	0.01
2003Z239B	<0.005	---	---	---	---	0.5	1.56	102	---	180	<0.5	<2	2.21	<0.5	13	79	7	2.55	---	0.24
2003Z243A	0.045	---	---	---	---	0.5	4.03	938	---	1390	2.7	<2	4.13	<0.5	26	494	22	5.07	0.02	2.37
2003Z244A	2.91	---	---	---	---	5.9	4.48	>10000	2.11	790	5.2	2	2.94	13.8	9	88	23	4.53	0.31	4.61
2003Z248A	<0.005	---	---	---	---	<0.5	0.42	170	---	30	<0.5	<2	2.46	<0.5	48	923	12	3.77	---	0.02
2003Z255A	<0.005	0.003	---	0.0038	0.003	<0.5	9.27	30	---	100	<0.5	<2	5.78	<0.5	30	41	152	7.78	---	0.15

Table 3. Concentration of trace elements in rock samples collected in the Livengood Quadrangle.

Note: --- = not analyzed.

SAMPLE	Mg %	Mn ppm	Mo ppm	Na %	Ni ppm	P ppm	Pb ppm	S %	Sb ppm	Sr ppm	Ti %	V ppm	W ppm	Zn ppm
2003MBW279D	0.20	371	2	0.76	20	190	3	0.02	<5	75	0.05	21	<10	18
2003RN113A	0.08	29	21	0.03	7	2520	4	0.04	11	12	0.04	216	<10	8
2003RN149A	0.02	>10000	23	0.02	126	2190	2	0.01	<5	22	0.02	26	<10	161
2003RN196A	0.07	2860	6	0.01	12	470	<2	<0.01	5	18	0.04	18	<10	16
2003Z34A	0.34	126	2	0.03	32	4420	11	0.07	15	55	0.15	187	<10	90
2003Z70C	0.05	124	11	0.02	31	980	4	0.01	28	11	0.02	90	<10	106
2003Z73A	>15.0	942	1	0.02	1755	10	<2	0.05	8	2	<0.01	22	<10	38
2003Z87A	>15.0	750	<1	0.01	1380	10	<2	0.06	15	8	0.01	30	<10	46
2003Z91A	10.55	1155	<1	0.01	1095	10	<2	0.32	16	546	0.01	33	<10	49
2003Z109B	0.10	24	7	0.02	9	>10000	5	0.05	15	88	0.06	93	<10	52
2003Z157B	0.05	8	3	0.01	3	770	<2	0.01	<5	5	0.03	54	<10	5
2003Z161B	0.08	77	10	0.02	7	930	8	0.01	5	20	0.05	94	<10	8
2003Z167B	0.04	25	8	0.04	14	270	<2	<0.01	<5	18	0.02	17	<10	16
2003Z178B	6.26	1795	<1	0.08	37	680	3	0.01	5	47	0.66	333	<10	59
2003Z198A	0.06	41	7	<0.01	7	3710	5	0.01	44	96	0.03	116	<10	59
2003Z214B	0.06	29	10	<0.01	11	100	<2	4.40	132	2	<0.01	6	<10	15
2003Z239B	1.08	2810	5	0.64	25	290	<2	0.01	<5	238	0.03	30	<10	31
2003Z243A	8.30	1090	<1	0.91	408	1280	16	0.17	12	704	0.16	91	<10	71
2003Z244A	2.69	712	2	0.20	144	530	2240	1.28	537	736	0.18	72	<10	1745
2003Z248A	14.55	677	16	0.01	949	40	<2	0.01	8	54	0.01	28	<10	46
2003Z255A	2.89	1350	<1	4.03	20	430	<2	0.01	<5	406	0.43	324	<10	61

Table 4. Location and description of rock samples collected for trace-element analysis in the Livengood Quadrangle.

SAMPLE	UTM E	UTM N	DESCRIPTION
2001MBW449A	429241	7266677	Intrusive; black, aphanitic groundmass; porphyritic, white feldspar phenocrysts. Possible hypabyssal monzonite plug or dike.
2001MBW450A	429169	7266760	Tan volcanic breccia cemented by black, aphanitic, siliceous material. Contains trace disseminated pyrite.
2001MBW456A	428953	7266109	Porphyritic hypabyssal volcanic (?) float with gray, fine grained, aphanitic matrix. Veins of quartz and unknown black mineral in patches and as crystals.
2001MBW456B	428953	7266109	Igneous (?) float is white-gray and fine grained with disseminated chalcopyrite +/- pyrite and other sulfides.
2001MBW457A	428856	7266091	Altered porphyritic volcanic rock is gray with strong iron-oxide staining and disseminated pyrite and arsenopyrite.
2001MBW458A	428820	7266075	Brecciated vuggy veins of quartz and arsenopyrite, lesser pyrite.
2003JEA36A	431297	7267388	Igneous float; gray, siliceous, with disseminated sulfide, pyrite (and arsenopyrite?).
2003JEA131A	440983	7269747	Sandstone or altered mafic subcrop; red, punky weathered, limonite matrix, brecciated (?).
2003JEA137A	431239	7274147	Gray chert float with trace amounts of fine grained, gray sulfide.
2003JEA144A	430009	7273478	Orange-gray chert float with iron oxide and silica breccia, quartz in matrix is vuggy with drusy texture and webbing.
2003JEA208A	438876	7266632	Large boulders of greenstone, possible breccia or tuff with patches of finer grained material, trace sulfide.
2003JEA256A	428134	7265603	Aphanitic plutonic (?) rock with rare disseminated sulfide. Red weathering.
2003JEA259A	429095	7265008	Serpentinite with pervasive and strong alteration of quartz, carbonate, and iron oxide.
2003JEA263A	425193	7265354	Altered sample of siliceous dolomite float; weathers orange, honeycomb to vuggy texture after pyrite or carbonate.
2003JEA264A	425159	7265310	Amy Dolomite (?) float; weathers cream-orange, vuggy, slight gray color in places suggests arsenopyrite.
2003MBW5C	428864	7266056	Arsenopyrite and quartz coarsely intergrown. Arsenopyrite is massive and highly altered to scorodite. Quartz is milky and brecciated.
2003MBW7A	428398	7265572	Silicious mudstone or silicified shale, surfaces are iron stained and locally cut by quartz and iron-oxide veins up to 1 cm wide. Open fractures are also iron oxide stained.
2003MBW9A	430052	7266066	Igneous dike outcrop with arsenopyrite disseminated and as vein fill.
2003MBW18C	433983	7273623	Vuggy chert breccia cemented by brown bottle-glass limonite.
2003MBW31A	433131	7272435	Black chert breccia float cemented by dark brown, bottle-glass limonite.
2003MBW64A	433854	7269447	Angular float at head of recent tailings. Light gray, granular, siliceous rock with rusty-orange iron staining. Brecciated, banded quartz veins.
2003MBW65A	433754	7269702	Siliceous outcrop with iron-stained vugs.
2003MBW66A	434399	7269902	Dolomite float, mostly pale gray and siliceous. Effervesces slowly. Cut by thin ≤ 1 mm black unknown stringers. Patches of tan rhomb-shaped clasts (?) (up to 3 mm in diameter) of possible dolomite in aphanitic, light gray matrix.
2003MBW74A	431761	7265967	Gabbro is dark green, fine grained (≤ 1.5 mm diameter crystals), equigranular, +/- hornblende?, clinopyroxene, plagioclase (30-50%), mafics (50-70%). Approximately 1% disseminated sulfide (either pyrite? or chalcopyrite?).
2003MBW79A	433127	7267465	Sheared, brecciated, +/- gossanous, +/- microveinlets of milky quartz, black, +/- iron-stained Amy unit silicified mudstone.
2003MBW107B	433724	7267431	Milky quartz vein 2.5 cm thick, crystalline, with open vugs.
2003MBW109A	433733	7267630	Bright orange-brown gossanous rocks, either massive or brecciated fragments replaced by and cemented by iron oxides. Other samples have bands and veins of limonite cutting them. Originally silicified mudstone/chert.
2003MBW109D	433733	7267630	White and brown siliceous rock with disseminated cubes (≤ 1.5 mm in diameter) of limonite (former pyrite).
2003MBW110A	433688	7267650	Igneous dike (?); extensive clay altering gives white/cream color. Vugs, +/- possible feldspar phenocrysts up to 2 mm in diameter. Green staining on some samples is possibly scorodite.
2003MBW178B	440406	7273430	Chert breccia with brown iron-oxide cement. Open fractures are stained with iron and manganese oxides.

Table 4. Location and description of rock samples collected for trace-element analysis in the Livengood Quadrangle.

SAMPLE	UTM E	UTM N	DESCRIPTION
2003MBW246A	428870	7267459	Serpentinite; very mottled where intensely altered.
2003MBW251A	428969	7267187	Felsic porphyritic dike; pale gray, granular matrix, open vugs (former mafics?), feldspar phenocrysts 3 mm long.
2003MBW255A	429167	7266762	Porphyritic dike; cut and brecciated by black aphanitic material with disseminated pyrite. Feldspar phenocrysts 4 mm long.
2003MBW256A	429198	7266655	Porphyritic dike or plug with dark gray matrix, white rectangular feldspar phenocrysts 5 mm long.
2003MBW259A	429051	7266651	Metasedimentary rock or dike; medium gray weathered surface.
2003MBW261A	428955	7266634	Porphyritic pluton or dike; gray-orange on the fresh surface, orange stained feldspar phenocrysts 5 mm long.
2003MBW262A	428925	7266658	Igneous float; aphanitic matrix, possible clear feldspar phenocrysts \approx 2 mm, weathered surfaces show weak orange-yellow staining.
2003MBW267A	428925	7266707	Porphyry float with vein fill of micro-veinlets of crystalline quartz coated with limonite.
2003MBW269A	429014	7266800	Igneous subcrop; pale gray on the fresh surface, iron-oxide staining.
2003MBW279D	429306	7266584	Milky quartz veins with pyrite and secondary limonite in sedimentary rock.
2003RN113A	438787	7273919	Chert breccia; dark gray to black, iron-oxide stained, with perhaps 1-2% former pyrite.
2003RN149A	432478	7276053	Chert breccia; pale gray, iron-oxide cemented.
2003RN196A	440972	7278040	Chert breccia; gray, abundant iron- and manganese-stains. Scattered quartz veinlets are randomly oriented. Local boulders 1 m cubed are abundantly iron- and manganese-oxide stained.
2003Z34A	432956	7275452	Chert pebble breccia with orange, brown, and black iron-oxide staining. Some vugs present in matrix.
2003Z70C	430365	7267888	Siltstone with abundant boxworks, lined with orange and brown iron-oxide stains.
2003Z73A	429889	7267665	Serpentinite; strongly silica-carbonate altered samples have stronger magnetic readings, trace (1%) disseminated sulfides are oxidized to limonite. Also dark gray to black sulfide clots forming discontinuous bands.
2003Z87A	429230	7267470	Serpentinite with trace amounts of disseminated pyrite in some samples. Minor quartz, +/- ankerite veinlets 2-3 mm. Moderate silica-carbonate alteration.
2003Z91A	429087	7267167	Serpentinite with orange and black, silica-carbonate altered surfaces and minor, green fuchsite. 1-2% fine grained, disseminated pyrite mostly \leq 1 mm across, but several grains up to 2 mm across.
2003Z109B	429994	7272298	Chert breccia with yellow to orange limonite cement.
2003Z157B	442125	7267825	Chert breccia; tan in color, with heavy iron-oxide orange coating and orange limonite cement.
2003Z161B	421437	7269546	Chert; dark gray, highly fractured with orange-brown limonite on surfaces.
2003Z167A	420358	7270605	Chert; highly limonite stained to orange and black.
2003Z178B	440375	7265549	Intermediate volcanic rock; gray to pale green-gray, fine grained. Fracture surfaces are commonly partially coated with manganese-oxide dendrites. Several fracture surfaces partially coated with bright green malachite and/or chrysocolla?
2003Z198A	431249	7272532	Siliceous mudstone; iron-oxide stained and containing quartz veins. Several pieces with slickensides and moderately gossanous.
2003Z214B	429596	7268758	Silicified dolomite with disseminated pyrite and pyrite in clots and stringers.
2003Z239B	429297	7266656	Conglomerate with common white 1-10 mm wide quartz veins and locally gossanous iron oxide.
2003Z243A	429681	7267608	Sucratic quartzite with disseminated pyrite and veinlets of quartz, pyrite, and arsenopyrite.
2003Z244A	429690	7267575	Sulfide-bearing quartzite breccia; 1 ft. x 1 ft. x 6 in. cobble with brecciated texture; other cobbles are quartz-veined. Malachite, pyrite, and arsenopyrite (1-2% of rock) in veinlets.
2003Z248A	428833	7267311	Low temperature silicification; quartz as botryoidal, drusy, and opalescent. Weak iron-oxide stains.
2003Z255A	427758	7266231	Gabbro with finely disseminated pyrite and minor chalcopyrite. Some chlorite alteration in open fractures.

Table 5. Limits and analytical methods for the major-oxide, minor-oxide, and trace-element analyses. Analytical method XRF = X-ray Fluorescence Spectrometry.

Elemental Oxide or Element	Analytical Method	Lower Detection Limit	Upper Detection Limit
SiO ₂	XRF	0.01%	100%
Al ₂ O ₃	XRF	0.01%	100%
Fe ₂ O ₃	XRF	0.01%	100%
CaO	XRF	0.01%	100%
MgO	XRF	0.01%	100%
Na ₂ O	XRF	0.01%	100%
K ₂ O	XRF	0.01%	100%
Cr ₂ O ₃	XRF	0.01%	100%
TiO ₂	XRF	0.01%	100%
MnO	XRF	0.01%	100%
P ₂ O ₅	XRF	0.01%	100%
SrO	XRF	0.01%	100%
BaO	XRF	0.01%	100%
LOI	XRF	0.01%	100%
Total	XRF	0.01%	100%
Ba	XRF	10 ppm	10,000 ppm
Nb	XRF	2 ppm	10,000 ppm
Rb	XRF	2 ppm	10,000 ppm
Sr	XRF	2 ppm	10,000 ppm
Y	XRF	2 ppm	10,000 ppm
Zr	XRF	2 ppm	10,000 ppm

Table 6. Limits and analytical methods for trace-element geochemical analysis.

Analytical methods include: FA-AAS = Fire Assay-Atomic Absorption Spectroscopy, ICP-MS = Inductively Coupled Plasma-Mass Spectroscopy, ICP-AES = Inductively Coupled Plasma-Atomic Emission Spectroscopy, CV-AAS = Cold Vapor-Atomic Absorption Spectroscopy.

Element	Analytical Method	Lower Detection Limit	Upper Detection Limit
Au1	FA-AAS	0.005 ppm	10 ppm
Au2	ICP-MS	0.001 ppm	1 ppm
Au3	FA-Gravimetric	0.05 ppm	1,000 ppm
Pt	ICP-MS	0.0005 ppm	1 ppm
Pd	ICP-MS	0.001 ppm	1 ppm
Ag	ICP-AES	0.5 ppm	100 ppm
Al	ICP-AES	0.01%	25%
As1	ICP-AES	5 ppm	10,000 ppm
As2	Aqua Regia-AAS	0.01%	30%
Ba	ICP-AES	10 ppm	10,000 ppm
Be	ICP-AES	0.5 ppm	1000 ppm
Bi	ICP-AES	2 ppm	10,000 ppm
Ca	ICP-AES	0.01%	25%
Cd	ICP-AES	0.5 ppm	500 ppm
Co	ICP-AES	1 ppm	10,000 ppm
Cr	ICP-AES	1 ppm	10,000 ppm
Cu	ICP-AES	1 ppm	10,000 ppm
Fe	ICP-AES	0.01%	25%
Hg	CV-AAS	0.01 ppm	100 ppm
K	ICP-AES	0.01%	10%
Mg	ICP-AES	0.01%	15%
Mn	ICP-AES	5 ppm	10,000 ppm
Mo	ICP-AES	1 ppm	10,000 ppm
Na	ICP-AES	0.01%	10%
Ni	ICP-AES	1 ppm	10,000 ppm
P	ICP-AES	10 ppm	10,000 ppm
Pb	ICP-AES	2 ppm	10,000 ppm
S	ICP-AES	0.01%	10%
Sb	ICP-AES	5 ppm	10,000 ppm
Sr	ICP-AES	1 ppm	10,000 ppm
Ti	ICP-AES	0.01%	10%
V	ICP-AES	1 ppm	10,000 ppm
W	ICP-AES	10 ppm	10,000 ppm
Zn	ICP-AES	2 ppm	10,000 ppm

