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MAJOR AND TRACE ELEMENT ANALYSES OF CRETACEOUS PLUTONIC ROCKS IN THE FAIRBANKS MINING DISTRICT, ALASKA

by

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MAJOR AND TRACE ELEMENT ANALYSES OF CRETACEOUS PLUTONIC ROCKS IN THE FAIRBANKS MINING DISTRICT, ALASKA

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Cretaceous granitic rocks comprise a small, but important part of the Fairbanks mining district, as they are spatially and temporally associated with much of the lode mineralization (Newberry et al., 1995). Rb/Sr, K-Ar, Ar-Ar and U-Pb dating of the quartz-rich plutonic rocks indicates that they were intruded at about 92 Ma; a small syenite plug on O'Connor Creek has a U-Pb age of 110 Ma (Newberry et al., 1996). As part of a continuing study of the geology of the Fairbanks mining district, granitic rocks have been collected and analyzed since 1975, but there has been no systematic compilation of major and trace element data. This report presents all available public sector analyses performed between 1980 and 1996, together with rock descriptions and locations.

Most of the analyses presented are from unweathered rocks showing no megascopic and little or no microscopic evidence for hydrothermal alteration (analyses 1 to 105). Up to 5% of the mafic minerals in these rocks show evidence for chloritization and plagioclase feldspars may exhibit a slight "dusting" by sericite. Consequently, the trace and major element contents of these rocks primarily reflect their primary igneous compositions. A few of the analyses presented (analyses 106 to 124) show hand specimen and/or thin section evidence for significant hydrothermal alteration: mafic minerals altered to chlorite +/- calcite +/- white mica +/- epidote +/- rutile and feldspars altered to white mica +/- quartz. Most of the analyzed samples do not contain obvious veining, however. The elemental contents of these rocks are only partly representative of the original magmatic compositions: "immobile" elements, such as Ti, Zr, Y, Nb, and Ga have changed the least, and "mobile" elements, such as Na, K, Ca, As, Cu, Sb, and Zn have probably changed the most.

About half of the major element analyses (Table 2) were performed by X-ray fluorescence (XRF) on fused glass disks by the ADGGS between 1980 and 1984. Some of these analyses were tabulated in

Burns et al. (1991), but accurate locations were not given. The remaining major element analyses were performed by several different commercial laboratories using XRF or Li-metaborate fusion/Inductively Coupled Plasma (ICP) techniques. A few samples were analyzed by XRF using pressed pellets at the University of Alaska. I consider only the TiO_2 values for these analyses to be truly quantitative and only list them. All major elements are listed in terms of weight percent oxides. Replicate analyses of split samples indicates that these values have uncertainties of approximately +/- 2% of the amount stated.

The samples were analyzed for trace elements (Tables 3-5) at a variety of laboratories, including the ADGGS atomic absorption (AA) lab, the University of Alaska XRF lab, and several commercial labs. The samples analyzed were split from the pulps remaining from the original major element analysis. Au, As, Cr, Cs, Eu, Hf, Lu, Nd, Sc, Sm, Ta, Tb, Th, and U were determined by Instrumental Neutron Activation Analysis (INAA). Ce, La, and Sb were mostly determined by INAA; a few samples were analyzed by XRF at the University of Alaska. Hg, Ag, Bi, Co, Cu, Li, Mo, Ni, Pb, and Zn were determined by AA and/or ICP. B was determined by delayed neutron counting. Cl and F were determined by specific ion electrode. W was determined by colorometric analysis and/or INAA. Ba, Ga, Nb, Rb, Sn, Sr, V, Y, and Zr were determined by XRF, mostly at the University of Alaska (as described in Newberry et al., 1994). A few samples were analyzed by XRF at a commercial lab. XRF analyses were also performed on several samples for the elements As, Cl, Co, Cr, Cu, F, Mo, Ni, Pb, Sb, Sc, Th, and Zn at the University of Alaska, as a check on analyses performed by other techniques at other labs. Five samples were also re-analyzed by ICP-MS at the Institute for Advanced Studies, Potsdam, Germany, and showed excellent agreement with the values given here. Replicate analyses of split samples and multiple analyses by several different techniques indicates that for most trace elements present at concentrations > 10 ppm, concentrations have uncertainties of approximately +/- 5% of the amount stated. Uncertainties for elements present at lower concentrations are approximately +/- 10% of the amount stated.

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TABLE 1: LOCATIONS

#	sample#	rock type	Latitude	Longitude
1	207	granite	64 56.5 N	148 5.9 W
2	89RN301	granite	64 53.8 N	147 22.2 W
3	89RN302	granodiorite	64 53.8 N	147 22.2 W
4	89RN303	granodiorite	64 59.7 N	147 21.3 W
5	89RN370	granodiorite	64 50.7 N	148 0.24 W
6	89RN371	granodiorite	64 50.6 N	148 0.4 W
7	95RN279B	granite	64 57.4 N	147 25.6 W
8	95RN306	tonalite	65 1.63 N	147 31.6 W
9	95RN340	tonalite	65 0.9 N	147 31.5 W
10	95RN409	tonalite	65 3.73 N	147 27.8 W
11	AH-2	tonalite	64 50.2 N	147 34 W
12	JKRyDk	aplitic granite	64 57.6 N	148 2.8 W
13	C134-186	tonalite	64 51.5 N	147 59.5 W
14	C134-233	tonalite	64 51.3 N	147 59.3 W
15	C23-245	granodiorite	64 51.3 N	147 59.5 W
16	C23-250	tonalite	64 51.3 N	147 59.4 W
17	Ecc-4-26	tonalite	65 2.2 N	147 29.6 W
18	Ecpd-205	tonalite	65 0.51 N	147 34.1 W
19	Ecpd-35	granodiorite	65 0.9 N	147 30.9 W
20	Ecc-2-124	granite	65 2 N	147 28.2 W
21	Ecpd-4-16	aplitic granite	65 0.53 N	147 34.7 W
22	Ecpd-46	granite	65 0.65 N	147 34 W
23	194-530	granite	64 59.8 N	147 21.8 W
24	50-1093	granodiorite	64 59.7 N	147 21.1 W
25	50-495	granite	64 59.6 N	147 21.1 W
26	88-126	granite	64 59.5 N	147 22 W
27	50-768	granite	64 59.6 N	147 21.1 W
28	57-385	granite	64 59.5 N	147 21.5 W
29	57-397	granodiorite	64 59.5 N	147 21.5 W
30	57-405	granite	64 59.6 N	147 21.5 W
31	57-82	granite	64 59.5 N	147 21.5 W
32	64-127	granite	64 59.6 N	147 22.2 W
33	64-470	granite	64 59.6 N	147 22.2 W
34	64-802	granite	64 59.6 N	147 22.2 W
35	67-96	granite	64 59.5 N	147 21.8 W
36	88-288	granite	64 59.5 N	147 22 W
37	88-30	granite	64 59.5 N	147 22 W
38	RN92-48	granite	64 59.6 N	147 47.2 W
39	agf-fgtn	tonalite	65 0.5 N	147 34.3 W
40	agf-maf	tonalite	65 0.5 N	147 33.9 W
41	agf-mgtn	tonalite	65 0.6 N	147 34 W
42	89rn78	tonalite	65 0.6 N	147 33.8 W
43	87rn328	tonalite	65 1.9 N	147 30.6 W
44	3989	granodiorite	65 1.25 N	147 28.8 W
45	3986	granodiorite	65 1.55 N	147 33 W
46	1589	granite	64 57.9 N	147 22.2 W
47	1588	granite	64 58.1 N	147 22.1 W
48	1590	aplitic granite	64 58.5 N	147 22.5 W
49	2438	aplitic granite	64 57.5 N	147 30.9 W
50	2294	aplitic granite	64 57.5 N	147 31 W
51	3681	granite	64 58.2 N	147 23 W

TABLE 1: LOCATIONS

#	sample#	rock type	Latitude	Longitude
52	3682	granite	64 58 N	147 22 W
53	3683	granite	64 59 N	147 20.3 W
54	3684	granite	64 58.2 N	147 27.4 W
55	3685	granite	65 1.7 N	147 27.8 W
56	3987	granite	64 59.7 N	147 21.6 W
57	3988	granite	64 59.8 N	147 21.2 W
58	3990	granite	64 58.3 N	147 20.6 W
59	3993	granodiorite	64 58.3 N	147 22.1 W
60	1587	granodiorite	64 58.2 N	147 22 W
61	3942	granite	64 58.2 N	147 23.1 W
62	3941	aplitic granite	64 58.2 N	147 23 W
63	3943	granite	64 57.6 N	147 22.4 W
64	3944	granite	64 57.7 N	147 23.1 W
65	3945	granite	64 58.7 N	147 22.7 W
66	3946	granite	64 58.4 N	147 24.2 W
67	3947	granite	64 58.3 N	147 24.3 W
68	3948	granite	64 58.2 N	147 23.8 W
69	3949	granite	64 58 N	147 25.8 W
70	3950	granite	64 58.3 N	147 25.9 W
71	3951	granite	64 58.2 N	147 27 W
72	3952	granite	64 58.2 N	147 27.4 W
73	3953	granite	64 58 N	147 27.8 W
74	3954	granite	64 58.3 N	147 26 W
75	3955	granite	64 58.4 N	147 25.7 W
76	3956	granite	64 57.9 N	147 27.2 W
77	3957	granite	64 57.6 N	147 26.9 W
78	3958	aplitic granite	64 57.5 N	147 24.7 W
79	3959	granite	64 57.4 N	147 26.1 W
80	3960	granite	64 57.6 N	147 23.8 W
81	3961	granite	64 58.1 N	147 28.3 W
82	3964	granite	64 57.2 N	147 27.5 W
83	3965	granite	64 57.2 N	147 25.8 W
84	3966	granite	64 56.9 N	147 26.5 W
85	3968	granite	64 57.3 N	147 21.3 W
86	3969	granite	64 57.9 N	147 28.9 W
87	3972	granite	64 56.8 N	147 29.8 W
88	3976	granite	64 58.4 N	147 14.7 W
89	3978	granite	64 58.4 N	147 18.8 W
90	3980	aplitic granite	64 58 N	147 20.1 W
91	3981	granite	64 58.3 N	147 19.2 W
92	3982	granite	64 58.4 N	147 19.8 W
93	3983	granite	64 59.1 N	147 18 W
94	3997	tonalite	65 1.25 N	147 34.5 W
95	3999	tonalite	65 1.6 N	147 31.3 W
96	1574	tonalite	65 2.1 N	147 29.6 W
97	1576	tonalite	65 0.55 N	147 34.3 W
98	1579	granodiorite	65 0.85 N	147 30.7 W
99	1581	granodiorite	65 2 N	147 27.8 W
100	1582	granite	65 1.7 N	147 28.3 W
101	1583	granodiorite	65 1.55 N	147 28.5 W
102	1584	granodiorite	65 1.35 N	147 28.5 W

TABLE 1: LOCATIONS

#	sample#	rock type	Latitude	Longitude
103	1586	tonalite	65 1.25 N	147 28.3 W
104	95BT300A	syenite	64 57 N	147 51.8 W
105	95BT300B	syenite	64 57 N	147 51.8 W
			ALTERED GRANITIC ROCKS	
106	95RN230	alt'd granite	65 1.25 N	147 39.3 W
107	95RN422	alt'd granite	65 3 N	147 33.3 W
108	C102-440	alt'd granite	64 51.2 N	147 59.3 W
109	C135-292	alt'd granite	64 51.3 N	147 59.4 W
110	C23-296	alt'd grd	64 51.1 N	147 59.4 W
111	ECC-1-22B	alt'd grd	65 2.8 N	147 26.2 W
112	81PM114	alt'd tonalite	64 51 N	148 4.75 W
113	81MH25	alt'd grd	64 54.2 N	147 35.7 W
114	agf-por	alt'd granite	65 0.7 N	147 33.9 W
115	agf-br	alt'd granite	65 0.65 N	147 34.7 W
116	AH-1	alt'd granite	64 50.2 N	147 34.3 W
117	95BT105	alt'd granite	64 54.7 N	148 16 W
118	95BT105c	alt'd granite	64 54.8 N	148 15.9 W
119	95BT106	alt'd granite	64 54.9 N	148 16.1 W
120	95BT117	alt'd granite	64 54.9 N	148 13.7 W
121	95BT142	alt'd granite	64 56.5 N	148 5.49 W
122	95BT43	alt'd tonalite	64 57.5 N	148 9.42 W
123	95KC156	alt'd granite	65 4.35 N	147 13.6 W
124	95DNS58	alt'd grd	65 4.86 N	147 23.5 W

TABLE 2: MAJOR ELEMENT COMPOSITIONS IN WT % OXIDES

#	SiO2	TiO2	P2O5	Fe2O3	FeO	Fetot	Al2O3	MnO	MgO	CaO	Na2O	K2O	LOI	SUM
1	74.4	0.04	0.1	0.32	0.9	1.32	13.98	0.03	0.02	0.91	3.25	4.8	0.74	99.5
2	70.4	0.31	0.12	0.63	1.3	2.07	14.8	0.04	0.64	2.31	3.29	4.2	0.62	98.8
3	62.9	0.48	0.21	0.96	3.8	5.18	15.0	0.14	3.27	4.21	3.71	3.16	0.77	99.0
4	66.6	0.45	0.2	0.64	2.7	3.64	15.2	0.1	0.84	2.55	4.02	3.0	1.62	98.2
5	62.8	0.73	0.18	0.69	4.2	5.35	15.2	0.11	1.61	4.72	2.38	3.57	1.31	98.0
6	65.1	0.64	0.19	0.83	3.5	4.71	16.2	0.08	1.26	4.58	2.66	2.95	0.85	99.2
7	73.3	0.15	0.03			1.48	13.33	0.03	0.28	1.52	3.14	4.91	0.39	98.5
8	59.2	0.86	0.21			7.08	15.19	0.13	3.5	5.76	2.26	2.92	1.87	99.0
9	64.0	0.74	0.19			5.89	15.53	0.1	1.96	4.67	2.32	3.17	1.1	99.7
10	63.5	0.74	0.16	3.5	2.5	6.28	15.74	0.09	2.47	5.25	2.21	2.49	1.15	100.0
11	63.9	0.75	0.17	0.55	5.2	6.32	14.7	0.1	2.37	5.93	2.17	2.01	0.9	99.3
12	70.1	0.23	0.02	0.95	1.35	2.45	14.57	0.05	0.27	2.46	2.79	3.46	2.16	98.6
13	62.1	0.94	0.23			7.00	15.33	0.11	2.41	5.5	1.89	2.29	1.3	99.1
14	60.5	0.96	0.19			7.04	15.0	0.12	2.71	5.91	1.8	2.6	2.35	99.2
15	69.5	0.41	0.16			2.89	14.92	0.03	0.78	3.00	2.65	3.52	2.04	99.9
16	60.4	1.02	0.19			7.70	15.07	0.12	2.29	6.04	2.32	1.88	1.41	98.5
17	59.7	1.03	0.27	1.17	5.76	7.56	17.17	0.13	2.56	6.33	2.13	3.16	1.25	101.3
18	61.6	0.85	0.21	1.92	4.95	7.41	15.53	0.13	2.72	5.9	2.02	2.67	1.32	100.4
19	65.9	0.66	0.21	0.06	4.15	4.67	16.02	0.11	2.04	4.52	2.53	3.5	1.32	101.5
20	74.2	0.11	0.03	0.05	1.11	1.28	13.64	0.05	0.34	1.46	3.69	3.8	0.64	99.2
21	71.0	0.03	0.02	1.19	1.22	2.54	16.27	0.01	0.23	0.23	2.98	5.46	1.3	100.0
22	73.6	0.02	0.01	0.65	0.82	1.56	14.35	0.03	0.11	1.04	2.84	5.36	0.91	99.9
23	70.7	0.33	0.27			2.20	15.26	0.03	0.6	2.51	3.64	4.17	1.65	101.4
24	68.4	0.41	0.33			3.41	15.54	0.08	0.69	2.41	3.63	3.86	1.1	99.9
25	69.4	0.33	0.31			2.86	14.86	0.06	0.73	2.98	3.43	3.78	1.26	100.0
26	69.8	0.38	0.33			2.59	15.59	0.05	0.68	2.74	3.77	4.03	0.72	100.6
27	69.8	0.32	0.31			2.69	14.85	0.05	0.7	2.89	3.23	3.76	1.44	100.0
28	71.8	0.25	0.22			1.69	15.05	0.04	0.48	2.21	3.23	4.82	0.66	100.5
29	61.4	0.86	0.33			7.24	15.85	0.13	2.01	3.78	3.02	3.25	2.07	99.9
30	73.0	0.26	0.23			1.68	14.25	0.03	0.47	2.1	3.23	4.25	0.68	100.2
31	70.5	0.27	0.24			1.99	15.06	0.03	0.66	2.17	3.00	4.84	2.06	100.9
32	72.4	0.24	0.22			2.01	14.14	0.04	0.55	2.21	3.05	4.44	1.01	100.3
33	70.3	0.31	0.21			2.11	15.21	0.04	0.52	2.43	3.37	4.35	0.64	99.5
34	69.8	0.29	0.24			2.51	15.06	0.05	0.62	2.58	3.42	4.06	1.3	100.0
35	70.0	0.41	0.25			2.90	15.32	0.05	0.78	2.99	3.39	4.25	0.78	101.1
36	68.4	0.41	0.3			3.35	15.72	0.07	0.85	2.78	3.63	3.69	0.97	100.1
37	71.7	0.27	0.23			2.09	15.13	0.05	0.61	3.11	3.39	3.34	1.07	101.0
38	67.6	0.42	0.16	2	1.3	3.44	15.01	0.07	1.06	2.78	3.57	4.92	0.57	99.6
39	62.7	0.79	0.25	1.24	4.69	6.45	15.4	0.11	1.55	4.75	2.36	3.3	1.63	99.3
40	60.6	0.92	0.26	2.15	4.69	7.36	15.2	0.12	2.7	5.95	1.99	2.36	1.31	98.8
41	60.7	0.88	0.27	1.75	5.24	7.57	15.1	0.13	3.13	5.9	2.01	2.58	0.87	99.1
42	59.8	1.03	0.25			7.13	16.1	0.11	3.72	6.20	2.4	2.71	0.7	100.1
43	60.1	0.98	0.22	0.8	5.6	7.02	15.9	0.12	3.68	6.15	2.28	2.5	0.8	99.7
44	62.8	0.68	0.26	0.94	3.65	4.99	14.84	0.14	3.74	4.84	3.75	2.91	0.6	99.6
45	62.8	0.64	0.23	0.99	4.07	5.51	14.61	0.16	3.52	4.4	3.12	2.65	0.78	98.4
46		0.45												
47		0.40												
48	74.3	0.03	0.04	0.43	0.95	1.48	13.49	0.02	0.03	0.61	4.33	4.47	0.57	99.4
49		0.03												
50	75.6	0.03	0.07	0.07	0.14	0.23	13.2	0.02	0.07	0.61	3.81	4.46	0.27	98.3
51	72.5	0.36	0.11	0.57	1.44	2.17	13.71	0.05	0.57	2.25	3.47	3.62	0.63	99.4

TABLE 2: MAJOR ELEMENT COMPOSITIONS IN WT % OXIDES

#	SiO2	TiO2	P2O5	Fe2O3	FeO	Fetot	Al2O3	MnO	MgO	CaO	Na2O	K2O	LOI	SUM
52	76.8	0.08	0.06	0.28	0.86	1.23	12.15	0.04	0.09	1.32	3.51	3.85	0.4	99.6
53	76.7	0.04	0.03	0.09	0.68	0.84	12.18	0.02	0.01	0.64	3.84	4.27	0.32	98.9
54	71.7	0.31	0.17	0.63	2.03	2.88	14.21	0.07	0.72	2.21	2.93	4.46	0.58	100.2
55	75.0	0.12	0.04	0.25	1.35	1.75	13.37	0.06	0.2	1.59	3.43	4.4	0.31	100.3
56	68.7	0.40	0.14	0.8	2.68	3.77	14.75	0.07	0.88	3.25	3.59	3.41	0.91	99.8
57	70.2	0.33	0.11	0.29	1.31	1.74	14.77	0.05	0.50	2.16	2.93	4.15	1.72	98.6
58	72.5	0.29	0.08	0.47	1.49	2.12	13.98	0.04	0.52	2.34	3.24	4.05	0.23	99.4
59	69.8	0.49	0.12	0.58	2.61	3.48	14.80	0.06	0.96	2.85	3.17	3.13	0.81	99.6
60	70.3	0.47	0.15	0.68	2.12	3.03	14.83	0.05	0.80	2.72	3.04	3.66	0.75	99.8
61	71.6	0.37	0.13	0.4	1.94	2.55	14.76	0.04	0.67	3.37	3.39	3.71	0.56	101.2
62	75.1	0.02	0.05	0.76	1.22	2.11	13.83	0.02	0.00	0.20	3.94	3.94	0.9	100.1
63	74.1	0.26	0.1	0.57	2.52	3.37	13.02	0.08	0.45	2.06	2.87	3.37	0.69	100.3
64	75.0	0.28	0.1	0.47	2.84	3.62	11.85	0.09	0.47	2.98	2.76	3.4	0.6	101.1
65	77.7	0.07	0.04	0.2	1.13	1.45	12.13	0.04	0.00	1.37	3.37	3.64	0.27	100.1
66		0.02												
67	76.3	0.04	0.06	0.1	1.04	1.25	12.59	0.03	0.00	0.97	3.7	4.27	0.25	99.4
68	75.9	0.06	0.12	0.09	1.04	1.24	13.08	0.03	0.03	0.83	3.82	5.8	0.36	101.3
69	75.3	0.06	0.04	0.18	0.95	1.23	12.94	0.03	0.02	1.01	3.51	4.48	0.41	99.0
70	71.2	0.28	0.08	0.45	2.93	3.70	14.50	0.08	0.54	2.36	3.28	3.66	0.95	100.6
71	70.0	0.29	0.09	0.27	2.57	3.12	14.23	0.06	0.51	3.33	3.24	3.59	0.94	99.4
72	69.7	0.41	0.14	0.46	3.33	4.16	13.58	0.1	0.95	3.22	2.79	4.01	1.03	100.0
73	74.7	0.14	0.09	0.29	1.53	1.99	14.38	0.05	0.24	1.66	3.14	4.46	0.71	101.6
74	71.8	0.32	0.09	0.41	2.79	3.51	12.75	0.1	0.56	2.13	2.9	3.47	0.74	98.3
75	68.6	0.39	0.1	0.83	3.47	4.68	14.51	0.13	0.16	2.32	3.22	3.78	0.41	98.3
76	71.4	0.35	0.07	0.42	2.61	3.32	13.90	0.1	0.42	2.21	3.21	3.41	0.53	98.9
77	74.9	0.07	0.07	0.11	1.32	1.58	13.05	0.04	0.00	1.48	3.39	3.9	0.14	98.6
78	73.2	0.02	0.05	1.13	1.45	2.74	13.68	0.01	0.00	0.29	3.89	4.6	0.72	99.1
79	74.3	0.12	0.06	0.18	1.55	1.90	12.52	0.06	0.03	1.58	3.25	3.59	1.16	98.6
80	73.0	0.20	0.07	0.64	1.49	2.29	14.40	0.05	0.38	1.91	3.03	4.46	0.51	100.3
81	76.7	0.05	0.12	0.35	0.54	0.95	12.89	0.02	0.11	0.96	3.69	4.56	0.46	100.5
82	72.9	0.22	0.08	0.41	1.53	2.11	13.79	0.05	0.30	1.95	3.28	4.13	0.38	99.2
83	74.7	0.04	0.04	0.15	0.63	0.85	13.14	0.02	0.00	1.21	3.71	4.65	1.17	99.5
84	72.6	0.24	0.09	0.53	1.85	2.58	14.23	0.06	0.57	1.99	2.99	4.15	0.72	100.2
85	74.9	0.31	0.11	0.43	1.31	1.88	13.93	0.05	0.31	2.38	3.13	3.55	0.62	101.1
86	72.5	0.26	0.1	0.57	1.98	2.77	13.88	0.06	0.53	2.26	2.93	4.31	0.43	100.1
87	74.0	0.13	0.05	0.29	1.31	1.74	13.75	0.03	0.23	1.50	3.2	5.05	0.36	100.0
88	74.5	0.20	0.08	0.47	1.53	2.17	13.43	0.05	0.36	1.73	3.03	3.89	0.85	100.2
89	73.6	0.18	0.06	0.38	1.53	2.08	14.11	0.04	0.35	1.70	2.82	4.69	0.62	100.2
90	74.4	0.02	0.09	0.96	0.59	1.61	13.59	0.02	0.00	0.28	3.8	4.53	0.71	99.1
91	73.6	0.16	0.06	0.47	1.44	2.07	13.73	0.05	0.33	1.70	3.15	4.48	0.42	99.7
92	76.1	0.08	0.05	0.24	0.68	0.99	12.77	0.02	0.09	1.58	3.2	4.45	0.35	99.7
93	70.9	0.32	0.14	0.49	2.21	2.94	14.50	0.08	0.65	2.52	3.11	4.19	0.38	99.7
94	59.4	0.92	0.22	1.09	5.67	7.38	16.52	0.12	3.81	6.62	2.5	2.52	0.73	100.7
95	59.7	0.95	0.23	1	6.03	7.69	16.05	0.14	3.72	6.20	2.56	2.43	0.7	100.3
96	62.0	0.86	0.21	1.08	5.07	6.71	16.34	0.12	2.56	5.43	2.45	2.75	0.14	99.5
97	62.5	0.89	0.19	1.11	5.36	7.06	15.78	0.12	2.94	5.61	2.14	2.69	0.64	100.5
98	65.4	0.67	0.21	1.29	3.96	5.69	15.99	0.08	1.19	3.50	2.36	3.5	1.11	99.7
99	70.6	0.40	0.15	0.65	2.16	3.05	14.80	0.05	0.66	2.97	3.53	3.09	0.59	99.9
100	72.8	0.19	0.08	0.4	1.22	1.75	13.80	0.04	0.50	1.75	3.44	3.93	1.66	99.9
101	67.0	0.57	0.19	0.95	3.15	4.45	15.05	0.09	1.07	3.53	3.54	3.00	0.88	99.4
102	65.3	0.78	0.22	0.83	4.41	5.73	14.95	0.09	1.52	4.55	2.64	3.19	0.39	99.4

TABLE 2: MAJOR ELEMENT COMPOSITIONS IN WT % OXIDES

#	SiO2	TiO2	P2O5	Fe2O3	FeO	Fetot	Al2O3	MnO	MgO	CaO	Na2O	K2O	LOI	SUM
103	63.5	0.71	0.2	0.59	4.37	5.44	15.78	0.11	2.42	4.55	3.05	2.24	1.23	99.2
104	64.9	0.04	0.02	1.4	1	2.51	17.7	0.15	0.06	0.05	8.18	5.14	1.52	100.3
105	64.4	0.04	0.02	1.8	1.2	3.13	17.19	0.15	0.04	0.17	9.15	4.02	1.75	100.0
	ALTERED GRANITIC ROCKS													
106	71.8	0.23	0.07			2.59	14.4	0.03	0.39	1.40	1.01	4.23	3.99	100.1
107	71.9	0.23	0.07			2.05	15.19	0.01	0.47	0.25	2.63	4.13	2.41	99.4
108	73.0	0.37	0.13			1.82	14.09	0.01	0.4	0.4	0.43	3.31	4.04	98.0
109	75.8	0.39	0.1			1.60	14.74	0.01	0.46	0.16	0.01	3.68	2.9	99.8
110	68.7	0.39	0.15			2.74	14.55	0.03	0.75	2.49	2.35	3.72	2.72	98.6
111	69.9	0.21	0.1	0.55	3.84	4.81	15.63	0.06	0.64	2.07	2.48	3.56	1.55	101.0
112	61.3	0.77	0.34	2.57	5.25	8.40	15.99	0.33	0.7	0.91	2.71	3.81	4.43	99.7
113	65.0	0.79	0.29	5.96	0.27	6.26	16.26	0.03	0.74	0.92	1.41	3.81	3.49	98.9
114	73.9	0.06	0.1	0.61	0.13	0.75	13.2	0.01	0.2	1.34	3.13	4.72	1.64	99.1
115	85.0	0.06	0.1	0.44	0.25	0.72	6.42	0.03	0.17	0.31	3.13	3.11	0.49	99.5
116	72.4	0.19	0.05	0.38	0.7	1.16	14.5	0.01	0.37	3.92	2.49	3.62	1.1	99.8
117	72.5	0.04	0.02			1.18	14.25	0.04	0.2	1.28	2.87	4.96	1.49	98.8
118	72.5	0.05	0.02			1.32	14.22	0.03	0.19	0.83	3.00	5.14	1.74	99.0
119	73.0	0.09	0.02			1.36	13.92	0.04	0.13	0.85	3.09	5.06	1.09	98.6
120	78.0	0.48	0.02			0.63	14.25	0.01	0.15	0.03	0.01	2.59	3.84	100.0
121	72.4	0.27	0.03			1.68	13.72	0.03	0.21	1.15	2.94	4.45	1.83	98.7
122	59.1	0.96	0.48			7.12	16.97	0.11	1.82	2.64	3.51	3.45	3.38	99.6
123	73.5	0.39	0.05			2.01	13.25	0.01	0.44	0.23	7.68	0.21	0.83	98.6
124	68.3	0.22	0.07			2.51	14.14	0.04	0.39	3.15	2.43	3.59	4.46	99.3

TABLE 3: TRACE ELEMENT CONCENTRATIONS, PART A

#	Au	Hg	Ag	As	B	Ba	Bi	Ce	Cl	Co	Cr	Cs	Cu	Eu
	ppb	ppb	parts	per	million---->									
1														
2			0.05	3	11	1385			370	3	27			
3						1440					70			
4				3	16	1300		81	380	7	57	15		1
5	1			5		1770		64	260	9	65	7		1.1
6	1			4		1780		65	200	7	83	10		1.4
7							2							
8							0							
9							0							
10														
11														
12														
13														
14														
15														
16														
17					10						82			
18					12						72			
19					10						64			
20					3						10			
21											33			
22					4						10			
23	2			2		1430	0.2			4			24	
24	1			2		1340	0.1		299	5			30	
25	110			5		1075	0.8		73	4			15	
26	2			1		1520	0.2			4			27	
27	125			2		1075	0.8			4			13	
28	7			1	4	1340	0.1			3			19	
29	3			5		1430	0.2		210	9			65	
30	168			2		1250	8			3			18	
31	18			1	3	1200	2.6			4			16	
32	26			1		715	2		20	4			15	
33	6			1	4	1160	0.1			3			14	
34	8			2		1078	0.05		57	4			15	
35	5			1		1520	0.05			4			23	
36						1700								
37	1			1		895	0.4			5			14	
38														
39	1.5		0.1	5		1900	1	85	210	8	80	9.4	46	0.7
40	2		0.05	7		1700	1	75	195	11	108	5.9	50	1
41	1.5			4.9		1700		77		14	100	6.4		1
42			0.05	5		1880	0.5	75		12			42	1.5
43						1729		74						1.5
44	3		0.05	10		1800	1		237	6	75		51	
45	2		0.05	8	8	1500	1			6	83		64	
46		3	0.4	7									83	
47		3	0.05	3									79	
48			0.1										45	
49	5		0.05	5									15	
50	9		0.1	5	22	130	0.5	5		0.5	5	31	23	

TABLE 3: TRACE ELEMENT CONCENTRATIONS, PART A

#	Au	Hg	Ag	As	B	Ba	Bi	Ce	Cl	Co	Cr	Cs	Cu	Eu
	ppb	ppb	parts per million---->											
51					9.4	1400		45			31			0.5
52					8	500		16						0.47
53					11	200		11					37	0.25
54					10	900		47						0.56
55	100		0.2		4.9	540		29						0.57
56	2		0.05	29		1700	3		90	4	30		51	
57	3		0.05	10	7	1680	1		340	3	18		24	
58	20		0.05	16		350	4		78	3	23		23	
59			0.05	5		1650		68			32	19	46	0.5
60	1	3	0.2	4		1900	0.5	80	126	4	39	17	53	1
61	9		0.1	5.7		900	3	51	20	4	28	19	47	
62	4					100		12	15	2	8	6.1	28	
63	4		0.1	8	5	550	2	40		3	24	14	46	
64	4		0.3	6.3		710	1	42	88	2	22	11	37	
65	3		0.2	10		370	7	22		3	21	10	65	
66														
67	58			7.7		100		5	20	2	5	13	68	
68	4		0.2	3.6		15	1	10		0.5	15	13	56	
69	4		0.05	4		18	2		15	0.5	25		16	
70	15		0.3	20		800	4			3	23		71	
71	9		0.6	26		650	3		15	3	22		73	
72	6			7.7	10	1700	1	73	130	4	25	23	57	0.97
73	8		0.4	8		740	1			2	15		58	
74	1		1.1	3.6		550	1	42	40	3	30	19	67	
75	3		0.3	12		1450	3	70		4	27	26	49	
76	4		0.2	16		650	2		15	3	43		77	
77	23			5.9		220		20	83	2	15	8.1	74	
78	19		0.4	4.2		40	0.8	7	15		10	6.9	23	
79	25			4.6		370		23	55	3	18	9.4	63	
80	15		0.05	4.6	5	550	3	26		2	27	7.8	15	
81	6			11		15	1			0.5	13		14	
82	4		0.05	6.2		780	3	38		2	22	4.8	13	
83	4		0.4	4.8		20	6	8		0.5	19	4.8	44	
84	4		0.05	15		850	1	33		2	24	10	14	
85	4			5		300	1	32		1	21	7.2	14	
86	6		0.05	7		900	1			2	31		24	
87	50		0.05	8.9		450	4	16				13	60	
88														
89	18			12		890	1		15	2	34		18	
90	13					70							42	
91	3		0.1	14		700	1		15	2	31		14	
92	4		0.05	1.2		520	1	11		0.5	16	6.1	13	0.43
93	4		0.1	26		1175	2			3	28		14	
94	2			3	7	1700	1			12			48	
95		13	0.05	4		1950	0.5	66	220	15	79	9	42	
96						1800			245					
97	1		0.1	6		1600	0.5			14	89	7.3	38	2
98	2	2	0.05	7		2150		75		9	64	6.9	58	
99		3		33		1600			269					
100		3		5.8		950			28		22			

TABLE 3: TRACE ELEMENT CONCENTRATIONS, PART A

#	Au	Hg	Ag	As	B	Ba	Bi	Ce	Cl	Co	Cr	Cs	Cu	Eu
	ppb	ppb	parts	per	million---->									
101	1	2	0.05	4		1450	0.5	89		4	41	16	69	1.11
102	4	10	0.05	7			1			6	59		41	
103	1	2	0.05	4.4		1520	0.5	96	194	10	50	7	40	1.4
104														
105														
106							1							
107														
108														
109														
110														
111					5	1000					18		146	
112	2			17		1200				13				
113	8			118		1700				9				
114	1			0.9		1700		40		3	210	4		
115	34			0.9		580		8.1		1	340	1.4		
116														
117							0							
118							1							
119							1							
120							4							
121							1							
122							1							
123														
124							0							

TABLE 4: TRACE ELEMENT CONCENTRATIONS, PART B

#	F	Ga	Hf	La	Li	Lu	Mo	Nb	Nd	Ni	Pb	Rb	Sb	Sc	Sm
		parts per million------>													
1															
2	420				54		1	17			21	119		3.5	
3								15				152			
4	1420	20.4	4.4	42	58	0.14	1	14	29	22	23	124		11	4.6
5	1550	20	5	59		0.2		12	24			109	0.7	12	5.3
6	1430		4.5	53		0.18		11	25			107	1.3	9	5.2
7		19					0	15		9	30	238	3		
8		18					2	10		7	20	95	0		
9		18					2	11		4	14	116	0		
10								10				80			
11								11				75			
12															
13															
14															
15															
16															
17															
18															
19															
20															
21															
22															
23	400						1				10		0.4		
24	1390						1				14		0.4		
25	780						1				14		0.2		
26	440						1				6		0.2		
27	760						1				14		0.4		
28	330						1				10		0.4		
29	1100						1				6		0.6		
30	320						1				8	126	0.4		
31	460						1				14		0.4		
32	290						1				14		0.4		
33	380						1				8		0.4		
34	360			31	36		1	12		14	12		0.2		
35	470						1				12		0.4		
36															
37	470						1				12		0.2		
38		18					1	8		9	18	148	1		
39	1200	18.4	5	47	45	0.5	1	13			16	133	1.1	17	7
40	1000	18	4	47	33	0.4	1	10			15	76	1.1	22	5.7
41		18	4	46		0.4	1	12				90	1	23	6.1
42	760			43		0.3	1		22	30	12			21	5.3
43	640			47		0.2		7	30			95		24	4.4
44		19					1	12		26	6	100	1		
45	1442	19.7					1	15		26	10	110	0.3		
46							3				10		1		
47							3				37		1		
48							12				26		1		
49							9				18		3		
50	210	21	2	6			10	30			15	380	1	1.7	2.2

TABLE 4: TRACE ELEMENT CONCENTRATIONS, PART B

#	F	Ga	Hf	La	Li	Lu	Mo	Nb	Nd	Ni	Pb	Rb	Sb	Sc	Sm
		parts per million------>													
51	640			27		0.24		14	14			220			3
52	80			6.9		0.83		20	5			220			1.9
53	20			8.2		1.52	12	30	5			320			2.2
54	1400			34		0.61		15	18			240			4.9
55	150			16		1.01	5	20	14		12	260	1		3.4
56		18					1	16		10	10	190	1		
57	250	17.9			36		1	13		6	10	130	1	3.3	
58		18.9		25	48		3	14		5	10	180	1		
59	1450	20	5	43		0.18	2	15			11	185	1	6.1	4.2
60	1000	20.9	6	47	64	0.19	2	16		12	15	194	5.4	4.3	7.1
61	670	18	4	46	75	0.19	4	14		18	28	195	1.9	5.1	3
62	450	27	3	5	14		4	39		7	17	310	1.4	0.1	1
63		17.2	4	23			2	16		14	18	190	1.2		3.6
64	1100	17	5	38		0.19		16		12	18	170	1.2	6.7	6
65	145		4	6			3	25		7	17	210	1.9	2.6	1.5
66												353			
67	75	21.4	4	2	17	0.5	12	31		5	21	320	2.2	3	2.6
68		25	3	4			2	36		8	23	360	1.1	2.6	2
69		20		5	24		4	30		3	23	350	0.3		
70		18.5					1	17		15	14	240	1		
71		20					2	15		14	28	210	7		
72	1950	20	6	42		0.63	2	19	31		38	264	2.5	8.8	6.9
73		17					4	15		9	12	228	1		
74	1800	17	4	30		0.19	1	16		13	16	200	1.5	7.1	4.5
75		21	5	47			1	18		9	21	248	3.4	8.7	6.1
76	1114	19.6					1	17		15	13	220	6		
77	145	18	4	7		0.3	5	20			18	210	1.2	3	2.8
78	85	27	3	3			3	37			18	340	1.2	0.1	2.1
79	295	17.4	4	8		0.2	4	16			17	230	1.4	3.1	2.5
80	75	16.3	3	18			2	14		6	15	190	0.4	4.9	2.3
81		22					1	45		1	24	350	1		
82		17.4	3	23			1	14		3	15	230	1	5.1	3.3
83			3	4			1	27			16	270	0.8	2.2	2.2
84		16.1	3	23			1	14		4	14	180	0.6	5.5	2.7
85	1367	14.5	3	11			2	12		3	11	155	0.8	4.6	2.2
86	758	17					2	15		3	12	225	1		
87		18	4	9			1	19			18	280	0.4	4.4	2.1
88															
89		16.5			35		2	14		4	11	205	1		
90		28					3	33				350			
91		16.9			37		2	15		5	19	200	1		
92		19	2.2	5.6		0.48	3	20	5.2	0.5	26	190	0.3	4.4	1.8
93		18.1					4	14		10	12	205	5		
94		18						9		27	5	83	1.3		
95	1071	18	5	42			1	10		26	12	83	2.7	22	5.7
96		18						11				98.5			
97	1240	18	5	45		0.2	2	11		21	13	87	1.9	25	7.3
98		19.4	5	48			1	12		16	7	130	1.3	13	6
99		20						15				180			
100		17					1	14				165	1		

TABLE 4: TRACE ELEMENT CONCENTRATIONS, PART B

#	F	Ga	Hf	La	Li	Lu	Mo	Nb	Nd	Ni	Pb	Rb	Sb	Sc	Sm
		parts per million------>													
101	1600	19.3	5.4	43		0.31	2	18	30	18	26	185	1.5	8.8	6.3
102								10		18	9	111			
103	1650	19	3.8	57	56	0.32	3	9	39	18	19	110	1.3	18	7.9
104								370				180			
105								340				160			
		ALTERED GRANITIC ROCKS													
106		16					1	10		6	41	149	21		
107								10				130			
108															
109															
110															
111										5	35				
112			9	65			1						3		
113			9	65			1						9		
114			3	19			1	18		11		148	0.5	2.4	3.8
115			2	4		0.3	1	8		11		117	1.1	1.8	2.1
116															
117		17					0	12		8	59	201	1		
118		18					0	12		7	61	208	4		
119		17					0	12		5	58	201	0		
120		16					0	10		5	9	103	8		
121		16					0	9		4	51	130	1		
122		22					3	23		6	17	132	0		
123								10				5			
124		16					1	10		4	35	119	8		

TABLE 5: TRACE ELEMENT CONCENTRATIONS, PART C

#	Sn	Sr	Ta	Tb	Th	U	V	W	Y	Yb	Zn	Zr
	parts per million------>											
1												
2		635					29		27		87	170
3		1040							20		80	158
4		1007		0.38	22	7	47		22	1.05	95	181
5		601	0.8	0.6	21	4.5		2	17	2.4	86	168
6		623	0.8	0.6	22	4		3	14	2.3	80	177
7	10	215			18			3	49		20	74
8	1	595			14			1	22		75	160
9	1	683			16			1	25		79	198
10		520							20			150
11		448							21			173
12												
13												
14												
15												
16												
17							127					126
18		450					120					157
19							67					185
20							10					43.5
21							10					50
22							10					34
23											44	
24											84	
25	10										52	
26	8										62	
27											48	
28											46	
29											120	
30	3	626									42	144
31	3										36	
32											46	
33											42	
34		612					40		26		44	
35											60	
36												
37											32	
38	3	453			7			1	9		46	128
39	3	606	0.9	1	19	5.1	88	1	18	3	81	198
40	3	655	0.8	0.8	16	4	136	1	16	2	77	163
41		620	0.9	0.7	16	3.3		1	13	2	79	158
42				1	15	2.7				2.2	84	
43		577		0.9	18	2.7			7	2.4		143
44		950			19	5.5			16		73	170
45	4	990			19	5			12		75	170
46	14							15			116	
47	16					11		10			69	
48	10							22				
49								18			9	
50	10		11.5	1.9	25	13		5	95	10	3	34

TABLE 5: TRACE ELEMENT CONCENTRATIONS, PART C

#	Sn	Sr	Ta	Tb	Th	U	V	W	Y	Yb	Zn	Zr
	parts per million------>											
51		600		0.6				2	30	2.01		100
52		120		0.9				3	50	4		50
53		30		1.6				3	90	8.16		35
54		470		0.9				3	40	3.23		90
55		160		1.2				3	50	4.88	18	40
56		690			20	4			20		80	165
57		740			12	3	23		22		48	145
58	10	531			15	5.5	25		22		40	121
59	10	765	1.6	0.6	22	7.7		1	18	2	74	170
60		820	1.7	0.6	23	6.5	38	7	26	2	110	160
61		635	1.8	0.6	15	3.5	30	8	20		43	150
62		21	8		28	10	1	3	77		8	41
63		330	3.3	0.9	21	5		2	32	4	51	119
64		270	3.7	1.3	18	5		1	35	4	56	122
65		165	4.3	0.6	16	9.5		2	59	5	18	71
66		56.6										
67		49	10	2	24	8.7	16	1	88	9	11	43
68	4	34	6.4	2	25	9		3	77	8	23	51
69		67	4			16	4		56		22	75
70		485			26	10			28		60	130
71		680			26	2			32		85	142
72		350	2.4	1.06	28	8		3	34	4.4	86	161
73	6	276	2.8		17	5			36		35	75
74		430	2.9	0.8	24	11		1	38	4	58	132
75		248	2.8	1.2	31	12		1	26	3	98	163
76	18	400			23	6			36		66	125
77		220	4.4	1.5	17	9.2		13	49	7	17	76
78		31	6.2	1	18	12		2	78	4	11	45
79		196	5.2	1.2	16	8		1	45	4	22	77
80		310	1.9	0.9	14	7		2	27	4	42	87
81		50	7.3		26	16			95		22	55
82		310	2.6	1.1	15	7.5		2	36	4	42	85
83		210	8	0.9	20	11		3	69	6	12	
84		340	1.7	0.6	17	6		1	25	4	54	100
85		300	2.6	0.8	15	3.1		2	28	4	35	75
86		330			14	6			33		51	115
87		210	4.4	1.3	18	10		4	60	5	22	90
88												
89		322			15	3	20		32		37	79
90		25	6			13			119		24	60
91		381			15	6	15		36		37	85
92	4	240	3.5	0.56	9.2	12		3	42	3.05	15	44
93	14	550			12	2			33		55	120
94	3	605			15	2		1	10		56	156
95	3	475	0.5	0.6	15	4.4		1	12	2	68	150
96		608			17	3			11		74	180
97		455	0.8	0.9	17	4		2	11	3	74	155
98	3	702	1.1	0.9	20	3.4		3	21	3	71	195
99		835			23	8		10	20		80	170
100		350			18	8		10	36		38	120

TABLE 5: TRACE ELEMENT CONCENTRATIONS, PART C

#	Sn	Sr	Ta	Tb	Th	U	V	W	Y	Yb	Zn	Zr
	parts	per million------>										
101		646	1.5	0.69	25	7.3		2	25	2.43	96	185
102		570			22			5	14		78	187
103		573	0.9	0.8	23	4.5	97	1	10	2.3	86	170
104		20							30			850
105		10							30			1010
			ALTERED GRANITIC ROCKS									
106	6	26			21			2	9		32	126
107		260							10			140
108												
109												
110												
111		330					10					115
112			1		19	5.5		8				
113			2		20	6.6		1			200	
114		138	0.9		14	3.5		1	9			116
115		137	1.1	0.6	8.6	2.6		3	25			54
116												
117	15	242			13			0	10		49	68
118	12	277			13			1	16		85	77
119	12	270			12			1	11		58	77
120	18	70			16			1	10		16	87
121	7	376			12			0	11		50	99
122	1	416			14			1	37		107	244
123		160							20			300
124	8	409			16			0	9		51	133