DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

Open-file Report
77-724
Table 1

Table 1.--Analyses of rocks related to Sleeping Butte caldera and biotite-hornblende rhyolite lava from Silent Canyon caldera

[Major oxide analyses 1, 2, and 14 by rapid methods by P. L. D. Elmore, S. D. Botts, G. W. Chloe, Lowell Artis and H. Smith; 3, 4, and 7-13 by P. L. D. Elmore, G. W. Chloe, H. Smith, J. Kelsey and J. L. Glenn; 5 by E. L. Munson. Minor element analyses 1, 2, and 14 by semiquantitative spectographic methods by J. C. Hamilton; 3, 4, and 7-13 by J. L. Harris; 5 by Joseph Haffty and H. G. Neiman. Analysis 6 from Cornwall, 1962, table 2. Leaders,---, no analyses made or constituent was absent.]

	Redrock Valley Tuff		Crater Flat Tuff						Crater Flat Tuff		Tuffs of Sleeping Butte			Lower biotite-hornblende rhyolite lava flow west of Split Ridge
			Bullfrog Member				Rhyolite lava flows intercalated between members of Crater Flat Tuff		Prow Pass Member		Lower shard tuff	Middle unit	Upper unit	
	Welded crystallized tuff		Basal vitrophyre	Welded crystallized tuff			Basal vitrophyre	Crystallized lava flow	Welded crystallized tuff		Slightly welded crystallized tuff	Crystallized tuff	Slightly welded crystallized tuff	Vitrophyre
Sample localities (figure 2)	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Field no.	11-134-2	TS4460d	CF 55 V	CF 115	0-7-84-3	BC 149	69FB1V	69FB1UV	0-1-70-13	CF 520	0-120-1-10	0-1-184-28C	0-1-184-31C	ENH-62-56
Chemical laboratory no.	160421	161152	W175495	W175496	D100349		W175497	W175498	W175499	W175500	W175501	W175502	W175503	160312
Spectrographic laboratory no.	301242	D110392W	W175495	W175496	D100349		W175497	W175498	W175499	W175500	W175501	W175502	W175503	

A. Major oxides (weight percent), recalculated without H_2O, F, Cl and CO_2 as $CaCO_3$.

SiO_2	72.5	73.3	72.8	74.0	75.05	75.86	75.3	79.1	74.9	76.0	75.1	73.3	73.4	73.9
Al_2O_3	15.0	14.3	14.8	14.2	13.01	13.38	13.9	11.6	13.5	13.6	14.0	14.8	14.9	14.4
Fe_2O_3	1.8	1.7	1.3	1.3	1.62	1.16	1.0	1.1	1.1	1.1	1.2	1.4	1.5	1.1
Sum as FeO	1.7	1.7	1.6	1.4	1.64	1.17	1.3	1.0	1.1	1.2	1.1	1.3	1.4	1.7
FeO	.06	.17	.45	.25	.18	.13	.37	.04	.08	.17	.06	.04	.08	.67
MgO	.34	.29	.39	.50	.42	.22	.33	.32	.32	.17	.22	.19	.16	.54
CaO	.53	.77	1.4	1.3	.62	.36	1.0	.75	.95	.36	.35	.51	.16	1.9
Na_2O	4.0	4.1	4.0	3.6	2.95	3.72	3.1	2.8	2.8	3.5	3.0	3.8	3.3	2.5
K_2O	5.4	5.1	4.3	4.4	5.85	4.99	4.6	4.0	6.0	4.7	5.7	5.1	6.2	4.5
TiO_2	.25	.18	.27	.18	.22	.13	.18	.18	.21	.21	.17	.10	.22	.30
P_2O_5	.06	.04	.04	.05	.04	.00	.03	.08	.02	.03	.03	.03	.03	.10
MnO	.06	.04	.04	.13	.04	.05	.08	.06	.06	.06	.08	.09	.09	.09
Total	100.0	100.0	100.1	99.9	100.00	100.00	99.9	100.0	99.9	99.9	99.9	100.0	100.0	100.0

B. Minor elements (weight percent).

B	<.002	<.002	.003	.002	.001	<.001	.002	<.002	<.002	<.002	<.002	<.002	<.002	----
Ba	.07	.1	.1	.1	.046	.050	.03	.02	.03	.02	.03	.02	.1	----
Be	.0002	.0005	.0005	.0005	<.0001	.0003	.0005	.0005	.0005	.0005	.0005	.0005	.0005	----
Ce	.02	.03	.05	.05	<.02	<.02	.03	.03	.03	.05	.03	.07	.05	----
Co	<.0005	<.0005	<.0001	<.0001	.0002	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	<.0001	----
Cr	.00015	<.0001	.001	.001	.0002	.0002	.001	.0015	.0015	.0005	.0007	.001	.0015	----
Cu	.0001	.001	.0001	.00015	.0003	.0002	.00015	.00015	.0001	.0001	.00015	<.0001	.00015	----
Ga	.003	.003	.0015	.0015	.0018	.001	.0015	.0015	.0015	.0015	.0015	.0015	.0015	----
La	.01	.01	.015	.01	.008	.006	.01	.01	.01	.01	.01	.02	.015	----
Mo	<.0005	.0005	<.0001	<.0001	.0002	<.0001	.0005	<.0001	<.0001	<.0001	<.0001	.0003	<.0001	----
Nb	.003	.003	.002	.002	.003	.002	.002	.002	.002	.002	.002	.002	.002	----
Nd	.015	.015	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	----
Ni	<.0003	<.0003	<.0003	<.0003	<.0003	<.0003	<.0003	<.0003	<.0003	<.0003	<.0003	<.0003	<.0003	----
Pb	.003	.003	.003	.003	.002	.003	.003	.003	.003	.003	.003	.002	.003	----
Sc	<.0005	<.0005	.0003	.0003	.0003	<.0002	.0003	.0003	.0003	.0003	.0003	.0003	.0003	----
Sr	.02	.03	.03	.03	.016	.02	.015	.01	.015	.01	.01	.015	.015	----
V	.003	.003	<.0002	<.0002	.0014	.0005	<.0002	<.0002	<.0002	<.0002	<.0002	<.0002	.007	----
Y	.005	.003	.005	.005	.0038	.004	.003	.003	.003	.003	.003	.005	.005	----
Yb	.0005	.0005	.0005	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0003	.0005	.0005	----
Zr	.02	.02	.05	.02	.022	.015	.015	.015	.01	.03	.02	.05	.03	----

C. Norms (weight percent), from recalculated analyses.

Quartz	27.1	28.3	29.4	32.7	33.7	34.1	37.0	45.5	32.9	36.6	34.9	30.4	29.9	37.5
Orthoclase	31.9	30.0	25.6	26.2	34.6	29.5	27.0	23.4	35.7	27.7	33.4	29.8	36.4	26.6
Albite	33.8	34.4	34.0	30.6	24.9	31.4	26.4	24.0	23.9	29.9	25.6	32.5	28.2	21.2
Anorthite	2.2	3.6	6.9	6.1	2.8	1.8	5.0	3.2	4.6	1.6	1.6	2.4	.6	8.8
Corundum	1.8	.8	1.0	1.2	.8	1.2	2.0	1.4	.6	2.2	2.4	2.2	2.5	2.2
Enstatite	.8	.7	1.0	1.2	1.0	.6	.8	.8	.8	.4	.6	.5	.4	1.3
Ferrosilite	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0	.0
Magnetite	.0	.2	.8	.7	.1	.2	1.0	.0	.0	.1	.0	.0	.0	1.6
Hematite	1.8	1.6	.8	.8	1.6	1.0	4	1.1	1.1	1.0	1.2	1.4	1.5	.0
Ilmenite	.3	.3	.5	.3	.4	.3	.3	.2	.3	.4	.3	.3	.4	.6
Rutile	.1	.0	.0	.0	.0	.0	.0	.1	.1	.0	.0	.5	.0	.0
Apatite	.1	.1	.1	.1	.1	.0	.1	.2	.0	.1	.1	.1	.1	.2
Total	99.9	100.0	99.9	100.0	100.0	99.9	100.0	99.9	100.0	100.0	100.1	100.1	100.0	100.0

D. Minerals (volume percent).

Quartz	0.1	0.4	2.8	2.2	1.1	4.8	2.1	2.4	1.2	2.9	(Phenocryst-poor)	0.8	1.1	<0.1
Alkali feldspar	6.3	5.0	3.9	6.6	2.6	7.9	1.8	2.3	3.5	5.2		10.1	8.5	0.1
Plagioclase	2/1.7	6.4	11.2	7.3	5.0	7.0	4.6	3.1	6.0	5.0		3.0	4.7	8.8
Biotite	0.6	0.8	1.4	0.6	0.9	0.3	0.7	0.5	0.2	0.1		0.4	0.7	1.7
Clinopyroxene	----	----	----	----	----	----	----	----	----	3/0.4		----	----	----
Hornblende	----	----	0.3	0.1	----	----	0.4	0.2	----	----		0.3	0.3	0.3
Sphene	----	----	tr	tr	----	----	----	----	----	----		----	----	tr
Opaques	0.4	0.6	0.3	0.3	0.1	----	0.1	----	0.2	0.3		0.4	0.2	0.3
Groundmass	2/90.9	86.5	79.3	82.5	84.6	79.4	90.3	91.5	88.9	86.1	99+	85.0	82.4	88.7
Lithic inclusions	----	----	0.8	0.4	5.7	----	----	----	----	----		<0.5	2.1	----
Points counted	3530	3740	3600	3400	3500	----	3600	3300	4100	1410	----	1620	1500	3560

E. Major oxides (weight percent), original analyses.

SiO_2	71.0	72.2	70.7	71.7	73.50	74.71	72.4	77.9	74.3	73.1	74.4	72.6	72.6	68.6
Al_2O_3	14.7	14.1	14.4	13.7	12.81	13.18	13.4	11.4	13.4	13.1	13.9	14.7	14.7	13.4
Fe_2O_3	1.8	1.7	1.3	1.3	1.60	1.14	1.0	1.1	1.1	1.1	1.2	1.4	1.5	1.0
FeO	.06	.17	.44	.24	.18	.13	.36	.04	.08	.16	.06	.04	.08	.62
MgO	.33	.29	.38	.48	.41	.22	.32	.32	.32	.16	.22	.19	.16	.50
CaO	.52	1.0	1.4	2.5	.82	.44	1.0	.74	0.9	2.0	.35	.51	.16	1.8
Na_2O	3.9	4.0	3.9	3.5	2.90	3.66	3.0	2.8	2.8	3.4	3.0	3.8	3.3	2.3
K_2O	5.3	5.0	4.2	4.3	5.76	4.91	4.4	3.9	6.0	4.5	5.6	5.0	6.1	4.2
H_2O+	1.9	.65	2.3	.61	.61	.69	3.4	.97	.75	.50	.90	.87	.63	4.6
H_2O-		.08	.21	.21	.37	.36	.35	.33	.25	.05	.20	.43	.11	1.8
TiO_2	.25	.18	.26	.17	.22	.13	.17	.18	.21	.20	.17	.69	.22	.28
P_2O_5	.06	.04	.04	.05	.04	.00	.03	.08	.02	.03	.03	.03	.03	.09
MnO	.06	.04	.04	.13	.04	.05	.08	.06	.06	.06	.08	.09	.09	.08
CO_2	<.05	.27	<.05	.98	.17	.08	<.05	<.05	.28	1.3	<.05	<.05	<.05	<.05
Cl	----	----	----	----	.06	----	----	----	----	----	----	----	----	----
F	----	----	----	----	.01	.03	----	----	----	----	----	----	----	----
Subtotal	----	----	----	----	99.90	99.73	----	----	----	----	----	----	----	----
Less O	----	----	----	----	.03	.01	----	----	----	----	----	----	----	----
Total	99.9	99.7	99.6	99.9	99.87	99.72	100.0	99.9	100.5	99.7	100.2	100.4	99.7	99.3
Powder density	2.58	2.56	----	----	----	----	----	----	----	----	----	----	----	----

1/ Precise locality not given in Cornwall, 1962, table 2.
2/ Plagioclase plucked during grinding; was probably originally subequal with alkali feldspar.
3/ Nearly all orthopyroxene; trace of clinopyroxene.