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Author(s) Barker et al,

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APP. TABLE 1. MODES (VOLUME PERCENT), INTRUSIVE ROCKS OF THE DIABLO PLATEAU

Rock type (Number of samples in parentheses)	Plagioclase	Alkali feldspar	Quartz	Nepheline + sodalite	Analcime	Olivine	Clino-pyroxene	Amphibole	Biotite	Opaques + aenigmatite	Others	Color index
Averages												
1 (3)	24.9	58.2	..	0.2	0.2	..	4.3	tr	8.0	2.7	1.3	16.3
2 (11)	..	75.3	..	1.6	5.9	1.1	8.8	1.0	3.4	2.8	0.1	17.2
3 (4)	..	79.6	..	..	10.3	1.2	2.3	1.4	tr	4.7	0.6	10.3
4 (5)	..	75.8	..	9.9	5.7	tr	3.3	2.7	0.2	1.9	0.5	8.6
5 (10)	..	67.6	..	8.0	11.3	0.6	8.6	0.6	0.2	2.5	0.6	13.1
6 (8)	..	69.6*	..	11.0	2.4	tr	15.7	tr	0.1	1.2	tr	17.0
7 (11)	..	71.5	..	5.4	6.1	tr	11.2	3.0	1.2	1.6	tr	17.0
8 (5)	..	91.9	2.4	..	..	..	0.6	0.4	0.7	3.1	0.9	5.7
9 (5)	..	84.8	1.4	..	..	..	0.9	0.3	tr	10.6	2.0	13.8
Ranges												
1	12.3-48.4	25.6-76.9	..	0-1.1	0.3-1.2	..	1.2-6.2	tr	3.8-13.5	2.0-4.1	tr-2.8	
2	..	54.8-83.6	..	0-11.2	0.8-13.0	9-3.1	0-39.2	0-9.2	0-9.8	0.2-8.6	0-0.2	
3	..	77.0-82.0	..	..	5.8-13.1	0-4.8	0.5-4.2	0.6-2.1	0-0.1	1.3-7.1	0-2.2	
4	..	73.0-79.2	..	5.8-16.5	2.7-10.4	tr	1.6-6.6	0.2-6.6	tr-0.4	1.0-3.1	0.2-0.8	
5	..	60.9-75.6	..	1.8-14.1	5.0-15.8	0-1.5	5.4-11.0	tr-2.8	0-1.6	0.6-4.0	0-2.8	
6	..	53.2-80.6	..	4.2-17.6	tr-9.4	tr	9.6-26.8	tr	tr-0.4	0.4-2.4	tr	
7	..	65.1-77.6	..	2.0-15.9	3.1-9.5	tr-0.2	6.6-14.4	tr-10.4	tr-3.7	0.2-4.1	tr	
8	..	84.1-98.5	0.6-4.8	..	..	..	tr-2.0	0-1.0	0.1-1.6	0.6-6.8	0.2-1.7	
9	..	82.4-88.4	tr-3.2	..	..	..	tr-2.6	tr-1.0	0-0.2	7.6-14.4	0.4-6.3	

tr = trace

* includes natrolite

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TABLE 2. ANALYSES (WEIGHT PERCENT), INTRUSIVE ROCKS OF THE DIABLO PLATEAU. ALL ANALYSES ARE BY G. K. HOOPS AND PREVIOUSLY UNPUBLISHED.

Rock type	1	1	2	2	3	3	3
Sample	AS-2	AS-5	CS-3	DC-1B	MAY-1B	MAY-3	MAY-4
SiO_2	54.10	55.15	55.40	56.50	58.10	57.50	57.30
TiO_2	1.81	1.28	0.08	0.49	0.59	0.63	0.76
Al_2O_3	18.60	18.41	18.80	17.50	17.80	17.50	17.80
Fe_2O_3	3.46	3.24	4.69	4.96	3.66	4.38	4.72
FeO	3.28	3.28	1.68	2.85	1.79	1.12	0.80
MnO	0.17	0.17	0.16	0.17	0.15	0.17	0.16
MgO	2.56	1.78	0.56	0.63	0.37	0.39	0.62
CaO	5.46	3.75	1.55	2.04	2.10	2.57	2.48
Na_2O	5.33	5.86	6.62	5.92	5.26	5.75	5.91
K_2O	3.67	4.71	5.65	5.14	6.35	5.77	5.75
H_2O^+	1.14	0.76	3.40	2.52	1.37	2.13	0.44
H_2O^-	0.08	0.11	0.40	0.56	0.49	0.41	0.86
P_2O_5	0.81	0.62	0.45	0.45	0.23	0.27	0.36
CO_2	0.26	0.22	0.47	0.30	1.02	1.16	1.11
Total	100.73	99.34	99.91	100.58	99.28	99.75	99.07

AS-2: chilled selvage, nepheline-bearing augite syenite.

AS-5: nepheline-bearing augite syenite.

CS-3: nepheline-bearing trachyte, Cornudas Station.

DC-1B: nepheline-bearing trachyte, Dell City.

MAY-1B: chilled roof selvage, Mayfield Valley.

MAY-3: nepheline-analcime syenite, Mayfield Valley.

MAY-4: nepheline-analcime syenite, Mayfield Valley.

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Table 2 - continued

Rock type	3	4	4	5	5	5	6
Sample	GM-1	DE-1	DE-5	WN-11	SA-1	WS-1	SA-12
SiO_2	57.40	56.90	57.05	58.60	56.40	55.90	55.20
TiO_2	0.17	0.51	0.44	0.11	0.21	0.21	0.44
Al_2O_3	18.80	19.80	20.17	18.54	18.10	18.10	17.56
Fe_2O_3	3.99	1.99	2.00	3.70	4.52	4.24	2.01
FeO	1.84	4.06	2.38	2.08	2.03	2.32	4.73
MnO	0.12	0.16	0.14	0.31	0.24	0.21	0.27
MgO	0.28	0.50	0.45	0.30	0.37	0.45	0.54
CaO	1.15	1.65	1.63	1.62	1.90	2.78	1.75
Na_2O	6.34	6.76	7.58	7.65	6.96	6.22	7.92
K_2O	5.65	5.55	6.12	5.47	5.27	5.31	3.50
H_2O^+	2.41	1.85	1.64	1.90	3.37	3.10	4.96
H_2O^-	0.55	0.00	0.15	0.17	0.30	0.33	0.42
P_2O_5	0.37	0.20	0.19	0.11	0.16	0.14	0.21
CO_2	0.13	0.44	0.48	0.26	0.60	0.00	0.03
Total	99.20	100.33	100.42	100.82	100.43	99.21	99.50

GM-1: nepheline-analcime syenite, Granite Mountain.

DE-1: nepheline syenite, Deer Mountain.

DE-5: nepheline syenite, Deer Mountain.

WN-11: nepheline syenite, Wind Mountain.

SA-1: nepheline syenite, San Antonio Mountain.

WS-1: nepheline syenite, Washburn Mountain.

SA-12: porphyritic pitchstone, talus cone, SE flank of San Antonio Mountain.

Table 2 - continued

Rock type	6	6	6	6	6	6-7	7
Sample	DE-4	DE-12	Z-2	CH-1	AL-11	AL-10	SP-39
SiO_2	55.60	55.60	57.35	56.10	58.40	58.10	60.70
TiO_2	0.43	0.30	0.22	0.18	0.21	0.14	0.09
Al_2O_3	17.95	17.35	18.64	19.57	18.80	18.55	17.68
Fe_2O_3	2.76	7.06	2.43	2.87	2.95	3.64	3.41
FeO	3.80	1.10	3.44	1.86	1.60	1.10	2.14
MnO	0.23	0.38	0.39	0.29	0.26	0.24	0.27
MgO	0.38	0.25	0.23	0.13	0.14	0.18	0.05
CaO	1.50	1.30	1.25	0.90	0.81	1.09	0.87
Na_2O	7.15	8.95	9.22	10.77	9.51	8.32	8.88
K_2O	5.37	4.20	5.08	4.90	4.98	4.84	4.97
H_2O^+	4.90	2.88	1.82	2.42	1.35	2.51	1.02
H_2O^-	0.52	0.30	0.12	0.22	0.05	0.21	0.12
P_2O_5	0.19	0.11	0.09	0.04	0.07	0.06	0.07
CO_2	0.05	0.13	0.12	0.08	0.05	0.21	0.07
Total	100.83	99.91	100.40	100.33	99.18	99.19	100.34

DE-4: devitrified glass dike in nepheline syenite, Deer Mountain.

DE-12: groundmass of phonolite dike, 1 km WSW of Deer Mountain.

Z-2: phonolite from plug, 3.7 km W of Wind Mountain.

CH-1: phonolite, Chattfield Mountain.

AL-11: phonolite, Alamo Mountain.

AL-10: foliated porphyritic nepheline syenite, transitional to phonolite, Alamo Mountain.

SP-39: chilled selvage, foliated porphyritic nepheline syenite, Sierra Prieta.

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Table 2 - continued

Rock type	7	7	7	7	7	7	7
Sample	SP-28	SP-3	CD-7	MIL-2	DM-3	DM-5	16M-2
SiO_2	59.70	59.50	60.20	60.80	57.00	59.10	59.10
TiO_2	0.11	0.05	0.17	0.12	0.19	0.14	0.15
Al_2O_3	17.80	17.30	17.98	17.25	18.40	17.95	17.95
Fe_2O_3	3.84	3.37	2.81	3.72	4.36	3.20	3.46
FeO	1.71	2.82	2.97	1.44	1.75	1.65	1.47
MnO	0.26	0.28	0.25	0.25	0.22	0.32	0.30
MgO	0.12	0.15	0.22	0.15	0.16	0.03	0.27
CaO	1.13	1.40	1.43	1.43	1.49	0.84	1.31
Na_2O	7.82	7.11	7.42	7.25	7.03	8.48	7.16
K_2O	5.21	4.92	5.45	5.15	5.60	5.25	5.45
H_2O^+	1.55	2.14	1.20	1.01	2.26	1.92	1.72
H_2O^-	0.21	0.27	0.20	0.21	0.36	0.20	0.60
P_2O_5	0.07	0.10	0.10	0.07	0.11	0.06	0.08
CO_2	0.12	0.29	0.42	0.35	0.18	0.00	0.20
Total	99.65	99.70	100.84	99.20	99.11	99.15	99.92

SP-28: foliated porphyritic nepheline syenite, Sierra Prieta.

SP-3: foliated porphyritic nepheline syenite, Sierra Prieta.

CD-7: foliated porphyritic nepheline syenite, Cerro Diablo.

MIL-2: foliated porphyritic nepheline syenite, Miller Mountain.

DM-3: foliated porphyritic nepheline syenite, Dog Mountain.

DM-5: foliated porphyritic nepheline syenite, Dog Mountain.

16M-2: foliated porphyritic nepheline syenite, Sixteen Mountains.

Table 2 - continued

Rock type	8	8	9	9	9	9	9
Sample	CO-1	CO-4	RH-3	GM-5	CD-6	16M-5	MIL-1
SiO_2	59.10	63.45	62.80	59.40	60.80	63.60	61.90
TiO_2	0.50	0.50	0.40	0.13	0.17	0.39	0.06
Al_2O_3	16.60	18.25	17.50	18.73	17.80	16.50	18.40
Fe_2O_3	1.42	2.33	5.85	5.35	4.78	2.37	4.71
FeO	1.13	0.92	0.44	0.22	0.20	0.15	0.25
MnO	0.12	0.14	0.12	0.03	0.10	0.19	0.30
MgO	0.81	0.07	0.05	0.10	0.14	0.20	0.07
CaO	4.97	1.20	0.36	1.63	0.85	1.95	0.45
Na_2O	5.99	6.70	6.00	4.66	6.98	7.22	7.70
K_2O	5.30	5.30	5.73	5.78	4.78	4.01	3.83
H_2O^+	1.04	0.72	1.26	2.38	1.24	1.33	0.77
H_2O^-	0.17	0.17	0.13	0.20	0.64	0.25	0.49
P_2O_5	0.16	0.18	0.18	0.37	0.09	0.07	0.07
CO_2	3.15	0.65	0.00	0.76	0.54	1.48	0.44
Total	100.46	100.58	100.82	99.71	99.11	99.71	99.44

CO-1: chilled selvage, quartz-bearing syenite, Cornudas Mountain.

CO-4: quartz-bearing syenite, Cornudas Mountain.

RH-3: quartz-bearing trachyte, Red Hills.

GM-5: quartz-bearing trachyte, Granite Mountain.

CD-6: quartz-bearing trachyte, Cerro Diablo.

16M-5: quartz-bearing trachyte, Sixteen Mountains.

MIL-1: quartz-bearing trachyte, Miller Mountain.

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TABLE 3. CIPW NORMS (WEIGHT PERCENT), INTRUSIVE ROCKS OF THE DIABLO PLATEAU. D.I. IS THE DIFFERENTIATION INDEX (THORNTON AND TUTTLE, 1960)

Rock type		1	1	2	2	3	3	3
Sample		AS-2	AS-5	CS-3	DC-1B	MAY-1B	MAY-3	MAY-4
	qz	..	..	..	..	0.41	..	..
	c	..	..	1.14	0.26	1.37	0.46	0.78
	or	21.68	27.83	33.38	30.37	37.52	34.09	33.97
	ab	42.43	40.89	41.50	48.99	44.51	48.22	47.99
	an	15.99	10.02	1.78	5.28	2.47	3.65	2.93
	ne	1.45	4.71	7.87	0.60	..	0.24	1.10
	ac	..	..	..	..	..	..	..
	ns	..	..	..	..	..	..	..
di	wo	1.74	1.31	..	..	..	..	..
	en	1.42	0.90	..	..	..	..	..
	fs	0.11	0.31	..	..	..	..	..
	wo	..	..	..	..	..	..	..
hy	en	..	..	..	..	0.92	..	..
	fs	..	..	..	..	2.59	..	..
ol	fo	3.47	2.48	0.98	1.10	..	0.68	1.08
	fa	0.30	0.95	2.51	0.50	..	1.03	0.40
	mt	5.02	4.70	5.70	7.19	4.55	2.34	0.90
	il	3.44	2.43	0.15	0.93	1.12	1.20	1.44
	hm	..	..	0.76	..	0.52	2.77	4.10
	ap	1.92	1.47	1.07	1.07	0.54	0.64	0.85
	cc	0.59	0.50	1.07	0.68	2.32	2.64	2.52
	D.I.	65.56	73.43	82.75	79.96	82.43	82.55	83.06

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Table 3 - continued

Rock type	3	4	4	5	5	5	6
Sample	GM-1	DE-1	DE-5	WN-11	SA-1	WS-1	SA-12
qz	..	..	..	..	..	..	..
c	1.35	1.17	..	..	..	..	..
or	33.38	32.79	36.16	32.32	31.14	31.37	20.68
ab	48.46	41.92	36.08	44.98	45.12	40.26	47.95
an	2.47	4.10	2.94	0.10	2.59	5.79	2.03
ne	2.81	8.28	15.20	10.70	7.46	6.70	10.33
ac	..	..	..	..	..	..	..
ns	..	..	..	..	..	..	..
di wo	..	..	0.36	1.88	0.84	2.00	2.13
di en	..	..	0.12	0.75	0.67	1.12	0.38
di fs	..	..	0.25	1.16	0.07	0.80	1.92
wo	..	..	..	0.44	..	0.96	..
hy en	..	..	..	..	..	..	..
hy fs	..	..	..	..	..	..	..
ol fo	0.49	0.87	0.70	..	0.18	..	0.68
ol fa	0.02	4.07	1.55	..	0.02	..	3.77
mt	5.79	2.89	2.90	5.36	6.55	6.15	2.91
il	0.32	0.97	0.84	0.21	0.40	0.40	0.84
hm	..	..	..	..	..	..	..
ap	0.88	0.47	0.45	0.26	0.38	0.33	0.50
cc	0.30	1.00	1.09	0.59	1.36	..	0.07
D.I.	84.65	82.99	87.44	88.00	83.72	78.34	78.96

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Table 3 - continued

Rock type	6	6	6	6	6	6-7	7
Sample	DE-4	DE-12	Z-2	CH-1	AL-11	AL-10	SP-39
qz	..	..	..	..	..	..	..
c	..	..	..	..	..	..	..
or	31.73	24.82	30.01	28.95	29.42	28.60	29.36
ab	39.02	38.47	33.21	28.65	37.17	46.19	43.32
an	1.03	..	..	..	..	..	..
ne	11.64	14.84	18.63	24.23	17.23	12.07	10.81
ac	..	8.69	7.03	8.30	8.53	1.70	9.87
ns	..	..	0.57	1.94	0.42	..	0.15
di wo	2.03	2.05	2.03	1.54	1.35	1.54	1.43
di en	0.39	0.48	0.18	0.14	0.15	0.28	0.05
di fs	1.80	1.70	2.07	1.57	1.34	1.38	1.56
wo	..	..	..	..	..	..	..
hy en	..	..	..	..	..	..	..
hy fs	..	..	..	..	..	..	..
ol fo	0.39	0.10	0.28	0.13	0.14	0.12	0.06
ol fa	2.02	0.41	3.56	1.61	1.34	0.66	2.10
mt	4.00	3.92	..	..	..	3.92	..
il	0.82	0.57	0.42	0.34	0.40	0.27	0.17
hm	..	1.35	..	..	..	0.35	..
ap	0.45	0.26	0.21	0.09	0.17	0.14	0.17
cc	0.11	0.30	0.27	0.18	0.11	0.48	0.16
D.I.	82.38	78.12	81.85	81.84	83.83	86.86	83.50

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Table 3 - continued

Rock type	7	7	7	7	7	7	7
Sample	SP-28	SP-3	CD-7	MIL-2	DM-3	DM-5	16M-2
qz	..	..	..	..	..	..	..
c	..	..	..	..	..	..	..
or	30.78	29.07	32.20	30.43	33.09	31.02	32.20
ab	48.24	53.68	49.38	55.62	41.56	40.75	49.56
an	..	0.76	..	..	2.12	..	0.75
ne	7.67	3.51	6.92	2.41	9.71	12.11	5.98
ac	3.18	..	0.56	1.13	..	7.62	..
ns	..	..	..	..	..	..	..
di wo	1.38	1.54	1.58	0.57	1.43	1.58	0.91
di en	0.30	0.20	0.23	0.37	0.17	0.04	0.67
di fs	1.18	1.49	1.49	0.16	1.40	1.73	0.15
wo	0.45	..	..	1.27	..	..	0.74
hy en	..	..	..	..	..	..	..
hy fs	..	..	..	..	..	..	..
ol fo	..	0.12	0.22	..	0.16	0.02	..
ol fa	..	1.03	1.54	..	1.47	0.92	..
mt	3.97	4.89	3.79	4.83	5.81	0.82	5.02
il	0.21	0.09	0.32	0.23	0.36	0.27	0.28
hm	..	..	..	..	0.35	..	..
ap	0.17	0.24	0.24	0.17	0.26	0.14	0.19
cc	0.27	0.66	0.96	0.80	0.41	..	0.45
D.I.	86.78	86.26	88.50	88.45	84.36	83.88	87.73

Table 3 - continued

Rock type	8	8	9	9	9	9	9
Sample	CO-1	CO-4	RH-3	GM-5	CD-6	16M-5	MIL-1
qz	1.24	3.29	5.46	9.54	1.48	3.80	2.37
c	..	1.25	1.21	4.49	1.07	..	1.96
or	31.31	31.31	33.86	34.15	28.24	23.69	22.63
ab	50.69	56.69	50.77	39.43	59.06	61.10	65.16
an	2.76	0.67	0.61	0.86	0.22	0.77	..
ne	..	..	..	..	..	..	..
ac	..	..	..	..	..	..	..
ns	..	..	..	..	..	..	..
di wo	0.39	..	..	..	..	0.58	..
di en	0.30	..	..	..	..	0.50	..
di fs	0.05	..	..	..	..	0.00	..
wo	..	..	..	..	..	2.94	..
hy en	1.71	0.17	0.12	0.25	0.35	..	0.17
hy fs	0.25	1.12	0.37	0.25	0.27	..	0.92
ol fo	..	..	..	..	..	..	..
ol fa	..	..	..	..	..	..	..
mt	2.06	1.97	0.65	0.43	0.48	..	1.61
il	0.95	0.95	0.76	0.25	0.32	0.72	0.11
hm	..	0.97	5.40	5.05	4.45	2.37	3.60
ap	0.38	0.43	0.43	0.88	0.21	0.17	0.17
cc	7.16	1.48	..	1.73	1.23	..	1.00
D.I.	83.24	91.30	90.09	83.24	88.79	88.59	90.15

1.

APPENDIX: ANALYTICAL TECHNIQUES

With the exception of fine-grained or glassy rocks, all major-element analyses were made on aliquots of crushed homogenized samples weighing from 1 to 3 kg. Colorimetric methods were used for determination of SiO_2, TiO_2, Al_2O_3, Fe_2O_3 and P_2O_5, based on the analytical scheme of Shapiro and Brannock (1962). However, in the HF decomposition of rock powder, HCl was substituted for H_2SO_4. Any fluorides were converted to chlorides by taking the solution to dryness twice in the presence of excess HCl. Finally, the chlorides were taken up with 1 percent HCl to form a stock solution for determination of Na, K, Mg, Ca, and Mn by atomic absorption spectrophotometry. To eliminate inter-elemental effects, 1500 ppm Sr (as $SrCl_2$) were added to both standards and samples (Abbey, 1968, p. 3). Ca was determined on suitable dilutions of stock solution, with 1 percent lanthanum added as a releasing agent. Ferrous iron was titrated with standard dichromate solution with diphenylamine sulfonic acid as the indicator. Total water was determined gravimetrically by the Penfield method. A gravimetric method was also used in the analysis for carbon dioxide.

Most of the whole-rock Rb and Sr concentrations were determined by an X-ray fluorescence (XRF) technique

described by DeLong and McCullough (1973). In the XRF procedure it is necessary to make corrections for the effect of the matrix composition. Mass absorption coefficients were calculated for each of the samples from the major-element chemical data (Table 3). Errors in Rb and Sr concentrations determined by XRF are estimated to range from about ± 5 percent if the element concentration is 20 to 50 ppm, to about ± 1 percent if the concentration exceeds 100 ppm (DeLong, 1974).

Rubidium and strontium analyses of some rock powders, and of all mineral separates, were performed by isotope dilution by a 60° sector field, 30.5-cm radius, solid-source mass spectrometer equipped with an expanded scale recorder. Analytical error in determination of Rb is estimated to be ± 1 percent, and for Sr, ± 0.5 percent. Repeated analyses of the Eimer and Amend standard give $^{87}Sr/^{86}Sr = 0.7082 \pm 0.0003$.

REFERENCES CITED

Abbey, S., 1968, Analysis of rocks and minerals by atomic absorption spectroscopy: Part 2. Geol. Survey Canada Paper 68-20, 21 p.

DeLong, S. E., 1974, Distribution of Rb, Sr and Ni in igneous rocks, central and western Aleutian Islands, Alaska: Geochim. et Cosmochim. Acta, v. 38, p. 245- 266.

DeLong, S. E., and McCullough, D., 1973, Compton-scattered tungsten X-rays as a measure of mass absorption coefficients in rocks: Amer. Mineralogist, v. 58, p. 1073- 1075.

Shapiro, L., and Brannock, W. W., 1962, Rapid analysis of silicate, carbonate, and phosphate rocks: U. S. Geol. Survey Bull. 1144-A, 56 p.