Kaiser Peak Quadrangle, Central Sierra Nevada, California— Analytic Data

GEOLOGICAL SURVEY PROFESSIONAL PAPER 644-C

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By PAUL C. BATEMAN *and* JOHN P. LOCKWOOD

SHORTER CONTRIBUTIONS TO GENERAL GEOLOGY

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By Paul C. Bateman and John P. Lockwood

ABSTRACT

Model data on the granitic rocks and chemical data on the granitic and metamorphic rocks of the Kaiser Peak quadrangle are presented. A simplified geologic map showing steeply dipping regional joints is included.

INTRODUCTION

This paper was prepared for use with the "Geologic map of the Kaiser Peak quadrangle, central Sierra Nevada, California," U.S. Geological Survey Geologic Map GQ 894 (Bateman, P.C., Lockwood, J.P., and Lydon, P.A.). It summarizes results of laboratory investigations conducted in conjunction with geologic mapping of the quadrangle and is part of a continuing series of geologic investigations of bedrock geology of the central Sierra Nevada batholith and enclosing rocks (Bateman and others, 1963; Bateman and Eaton, 1967).

The Kaiser Peak quadrangle is approximately 60 miles northeast of Fresno, Calif. It lies, for the most part, between 6,500 and 9,500 feet and is heavily forested—only small areas of the quadrangle along its southern and northeastern boundaries are above timberline.

GENERAL GEOLOGY

The geologic history of the quadrangle is briefly summarized in a text that accompanies the geologic map (Bateman and others, 1970). A generalized, small-scale version of this map is shown in figure 1. The oldest rocks of the quadrangle are highly metamorphosed marine sedimentary and volcanic deposits of early Mesozoic and possibly Paleozoic age. They are intruded by Mesozoic granitic plutons of two and possibly three ages; these plutons range in composition from quartz diorite to alaskite. Granitic rocks make up more than 90 percent of the bedrock in the quadrangle, and most of the analytic data pertain to them. The granitic and pregranitic rocks are overlain by volcanic flows of late Tertiary age and by unconsolidated glacial and alluvial deposits of Quaternary age.

ANALYTIC DATA

During the course of geologic mapping, about 300 samples of representative rocks were collected from the quadrangle. Of these samples, the specific gravity and modal mineral composition of 247 samples of granitic rock were determined. For modal analyses, the samples were sawed to yield slabs with flat surfaces of at least 6 square inches; these slabs were then stained so that the two feldspars could readily be distinguished from each other and from quartz. The mineral constituents (quartz, K-feldspar, plagioclase, or mafic minerals) present at each of 1,000–2,000 regularly spaced points on each slab were then observed with a microscope and tabulated.[1] The volume percentage of these minerals was then calculated for each sample locality; the values are shown on simplified bedrock maps of the quadrangle (figs. 2-5). Using these data, contours were drawn by visual inspection wherever feasible to show the distribution patterns of each mineral. Specific gravities and a contour map of the specific-gravity data are given in figure 6. Figure 7 shows the pattern of steeply dipping regional joints.

In addition to the modal analyses of granitic rocks, 15 samples of granitic rocks from six different plutons, two samples of pregranitic volcanic rocks, and five samples of Tertiary volcanic rocks were analyzed

[1] Analysts: M. B. Norman and M. G. Hoerster.

chemically. The locations of the chemically analyzed samples are shown in figure 1. All but one of the samples were analyzed by the rapid method of Shapiro and Brannock (1962); one sample of granitic rock was analyzed by standard chemical methods (Peck, 1964). These data, together with semiquantitative spectrographic analyses, CIPW norms, and modes of the granitic rocks are tabulated in table 1.

In figure 8, the modes of the granitic rocks, normalized to 100 percent, are plotted on triangular diagrams whose corners are quartz, plagioclase, and K-feldspar. In addition, norms of the chemically analyzed samples are plotted on a triangular diagram whose corners are normative quartz, plagioclase (albite plus anorthite), and orthoclase.

REFERENCES

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Bateman, P. C., and Eaton, J. P., 1967, Sierra Nevada batholith: Science, v. 158, no. 3807, p. 1407–1417.

Peck, L. C., 1964, Systematic analysis of silicates: U.S. Geol. Survey Bull. 1170, 89 p.

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

FIGURES 1-8 AND TABLE 1

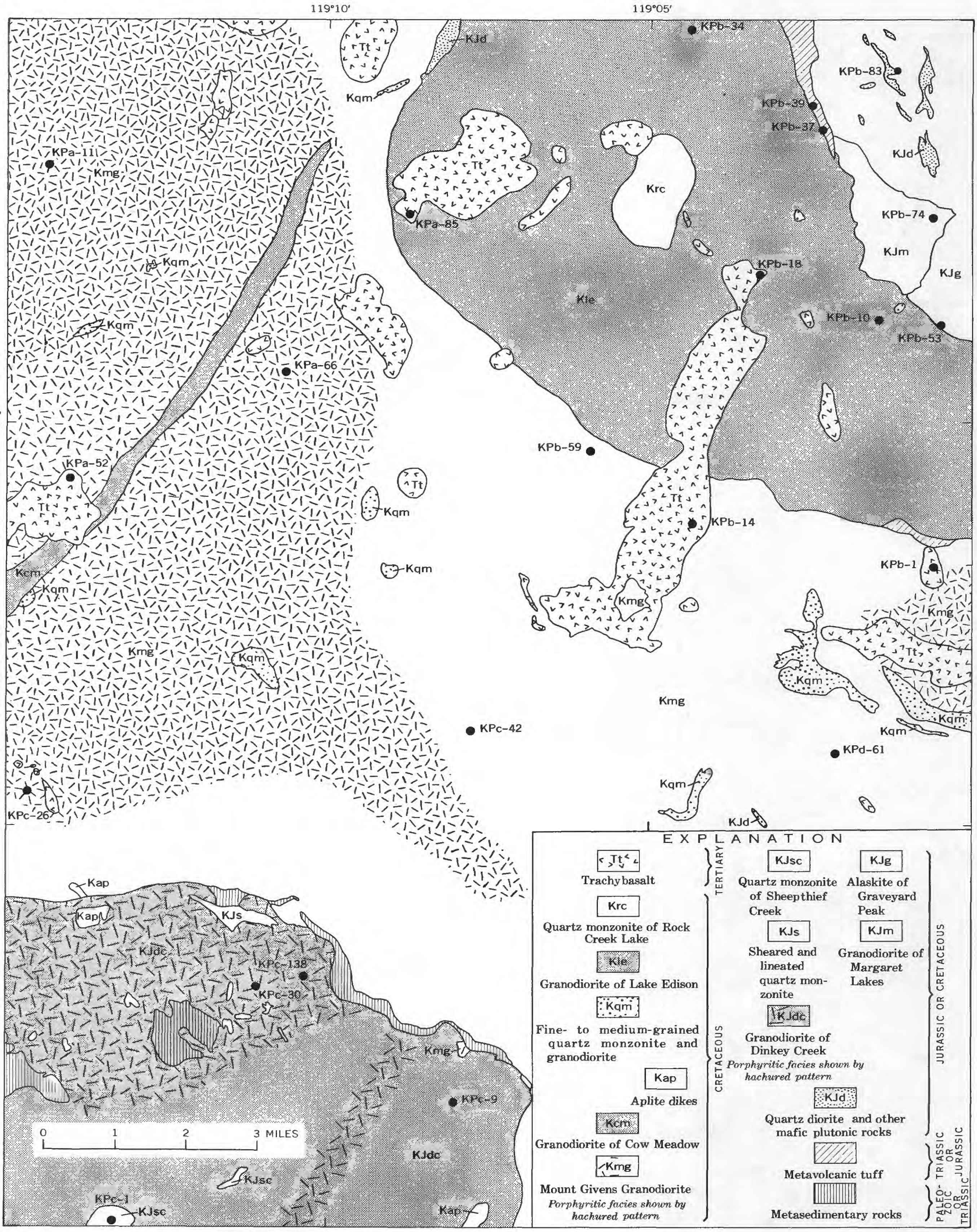

FIGURE 1.—Simplified geologic map of Kaiser Peak 15-minute quadrangle showing locations of chemically analyzed samples.

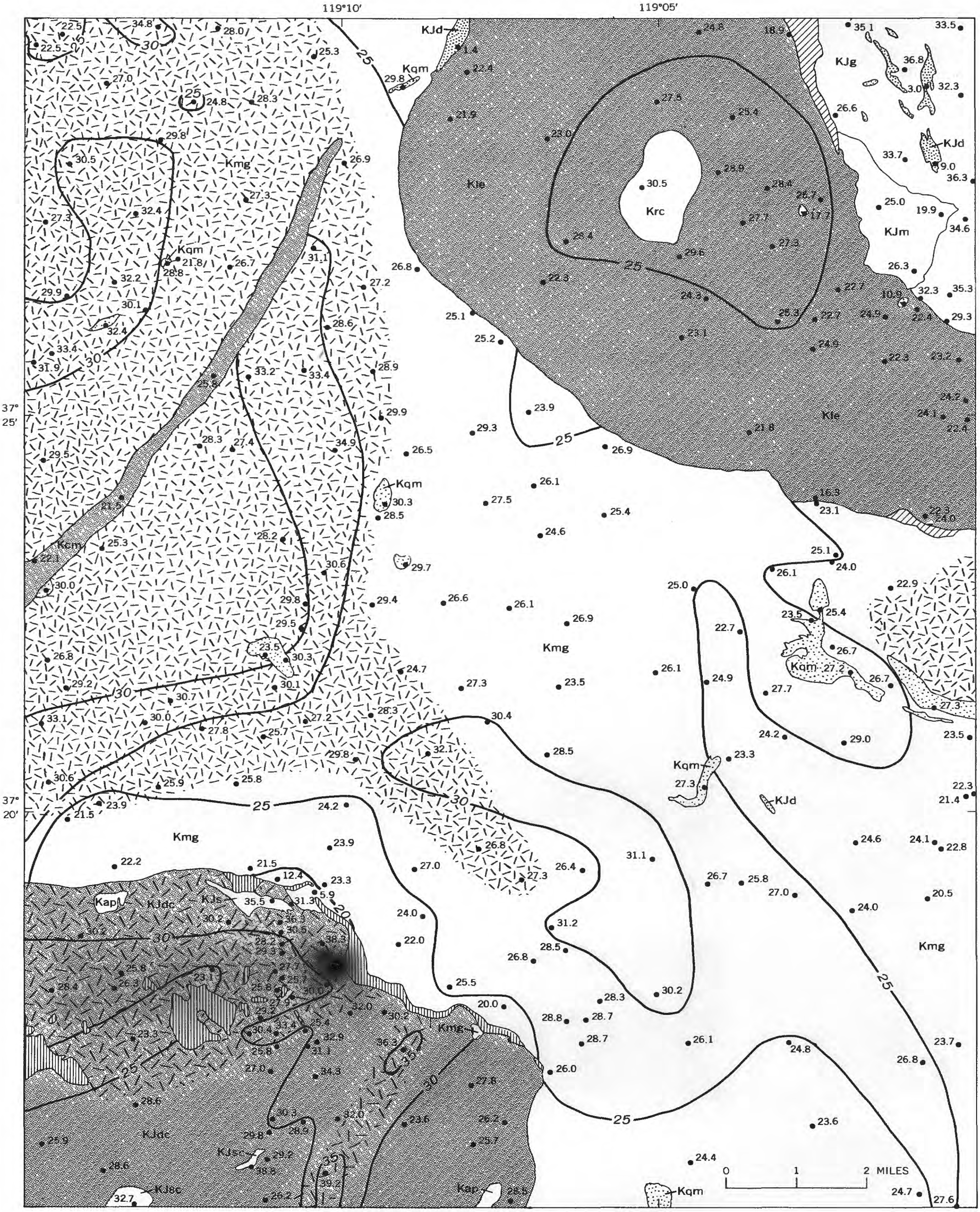

FIGURE 2.—Bedrock map showing volume percent quartz.

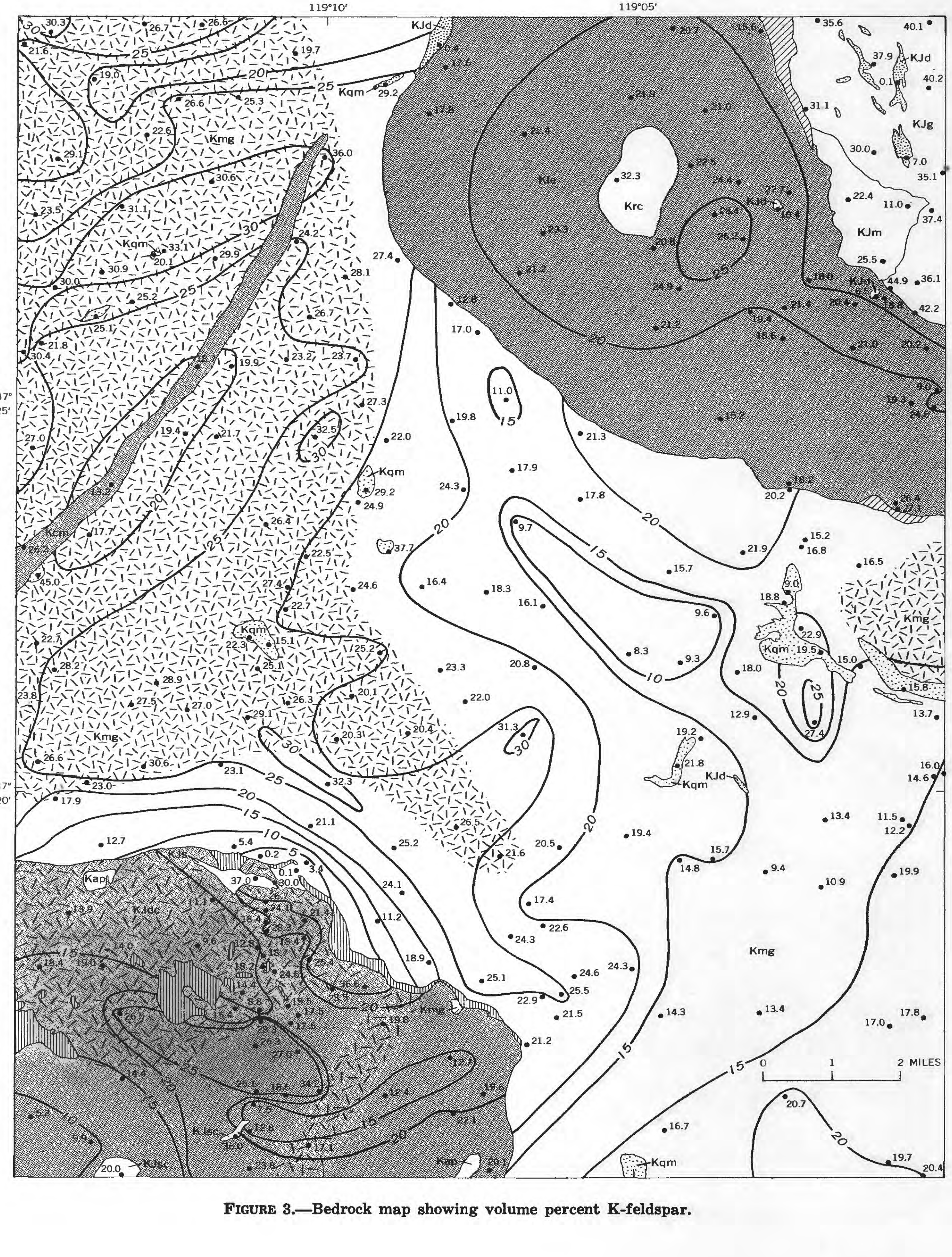

Figure 3.—Bedrock map showing volume percent K-feldspar.

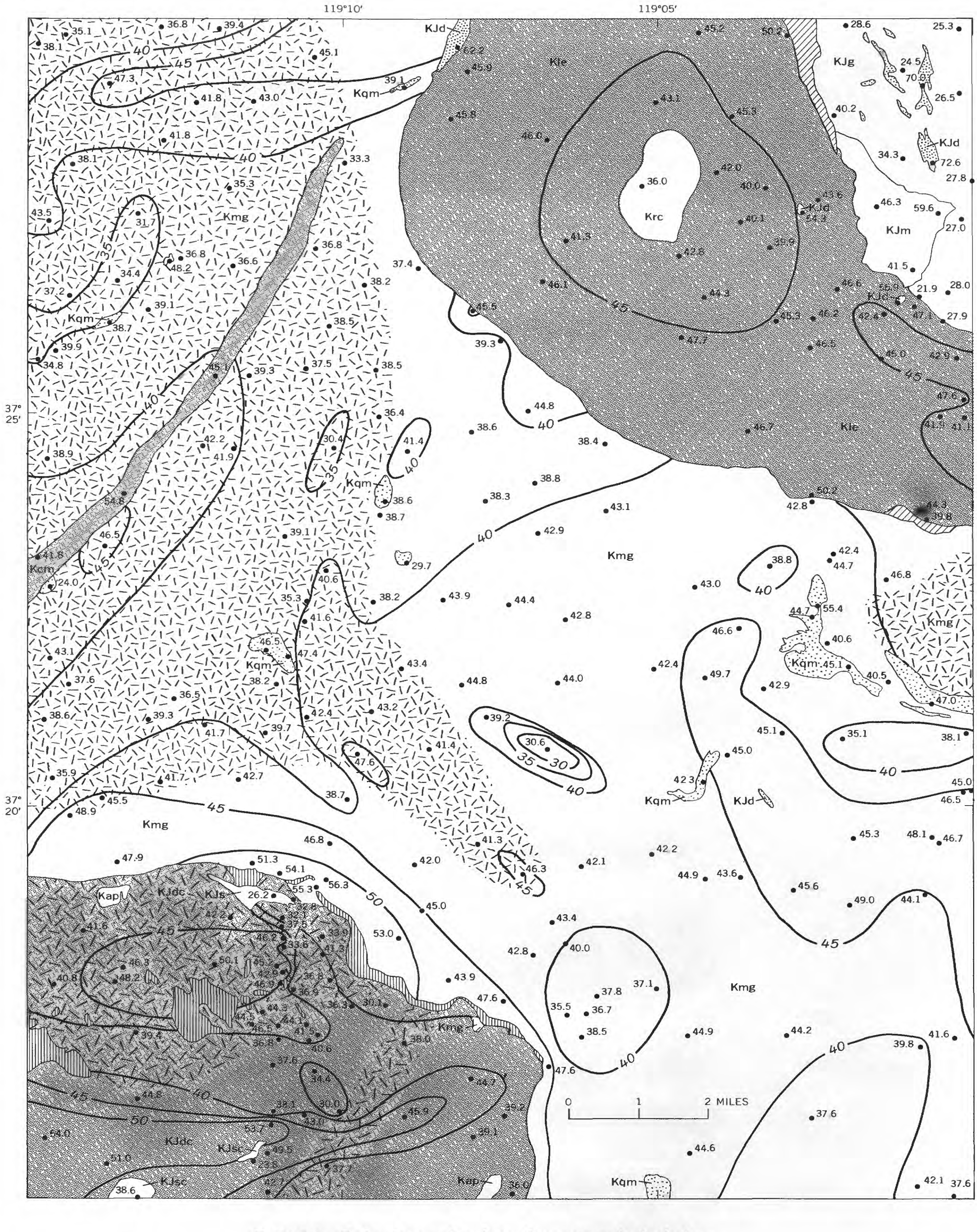

FIGURE 4.—Bedrock map showing volume percent plagioclase.

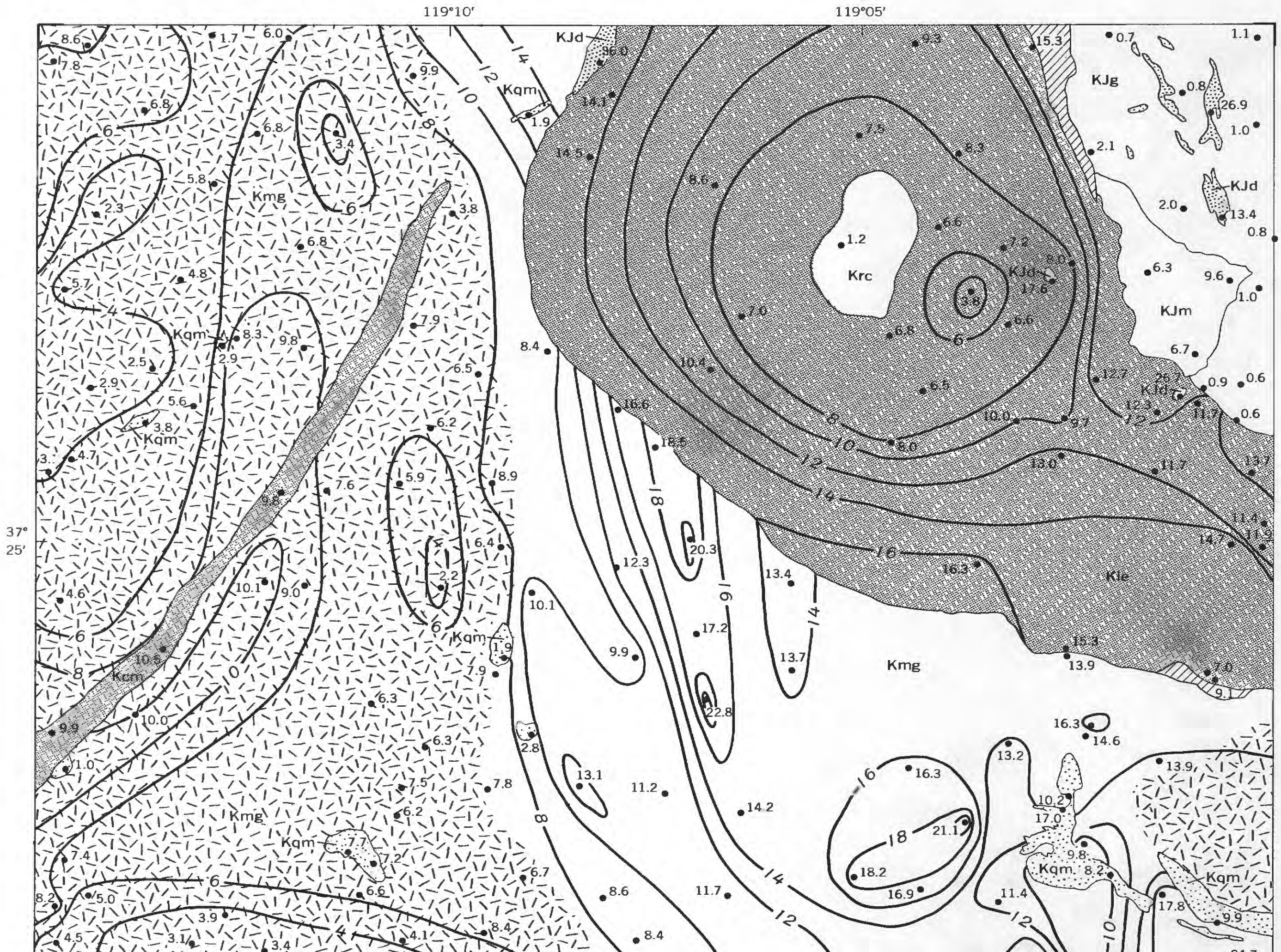

FIGURE 5.—Bedrock map showing volume percent mafic materials.

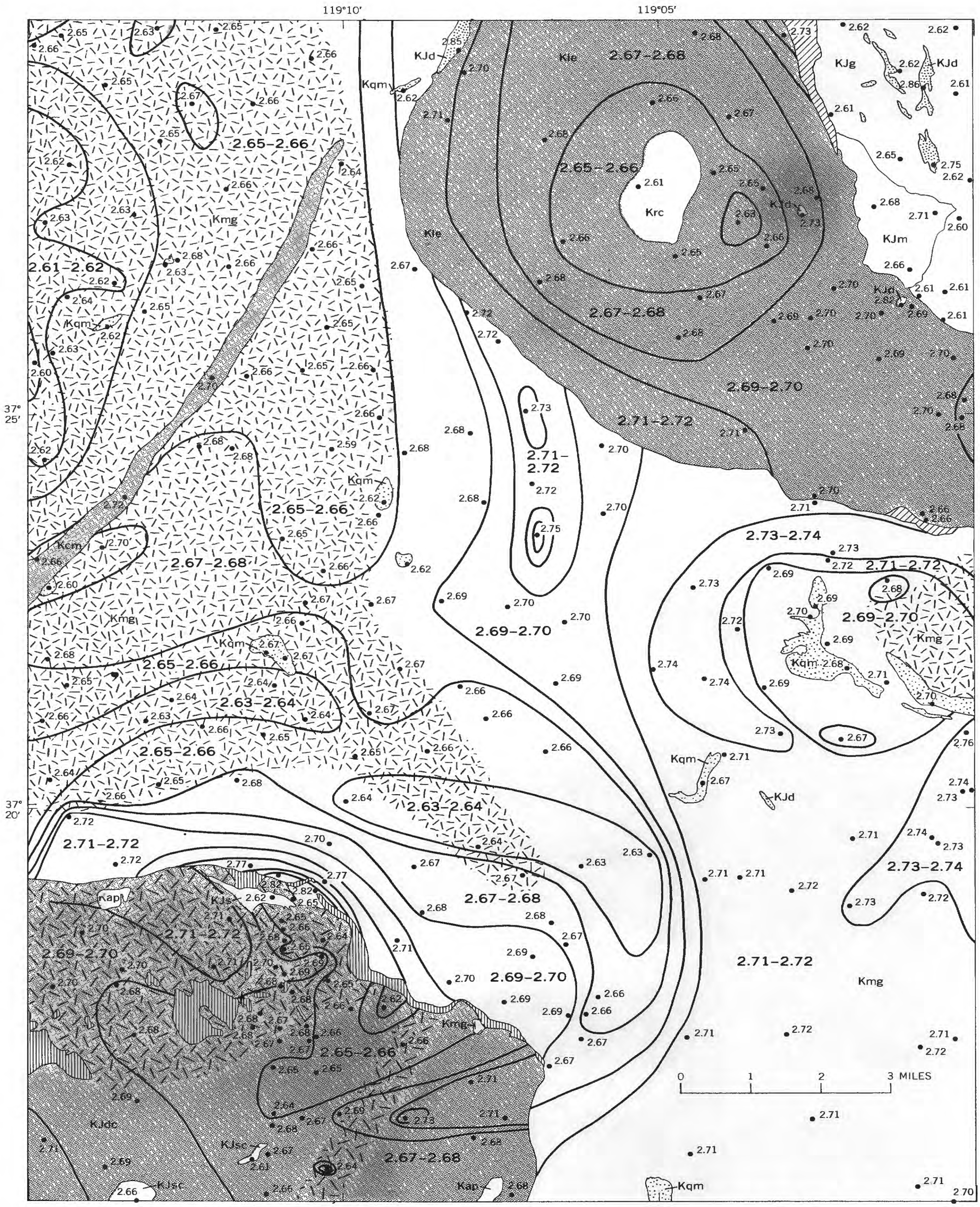

FIGURE 6.—Bedrock map showing specific gravity.

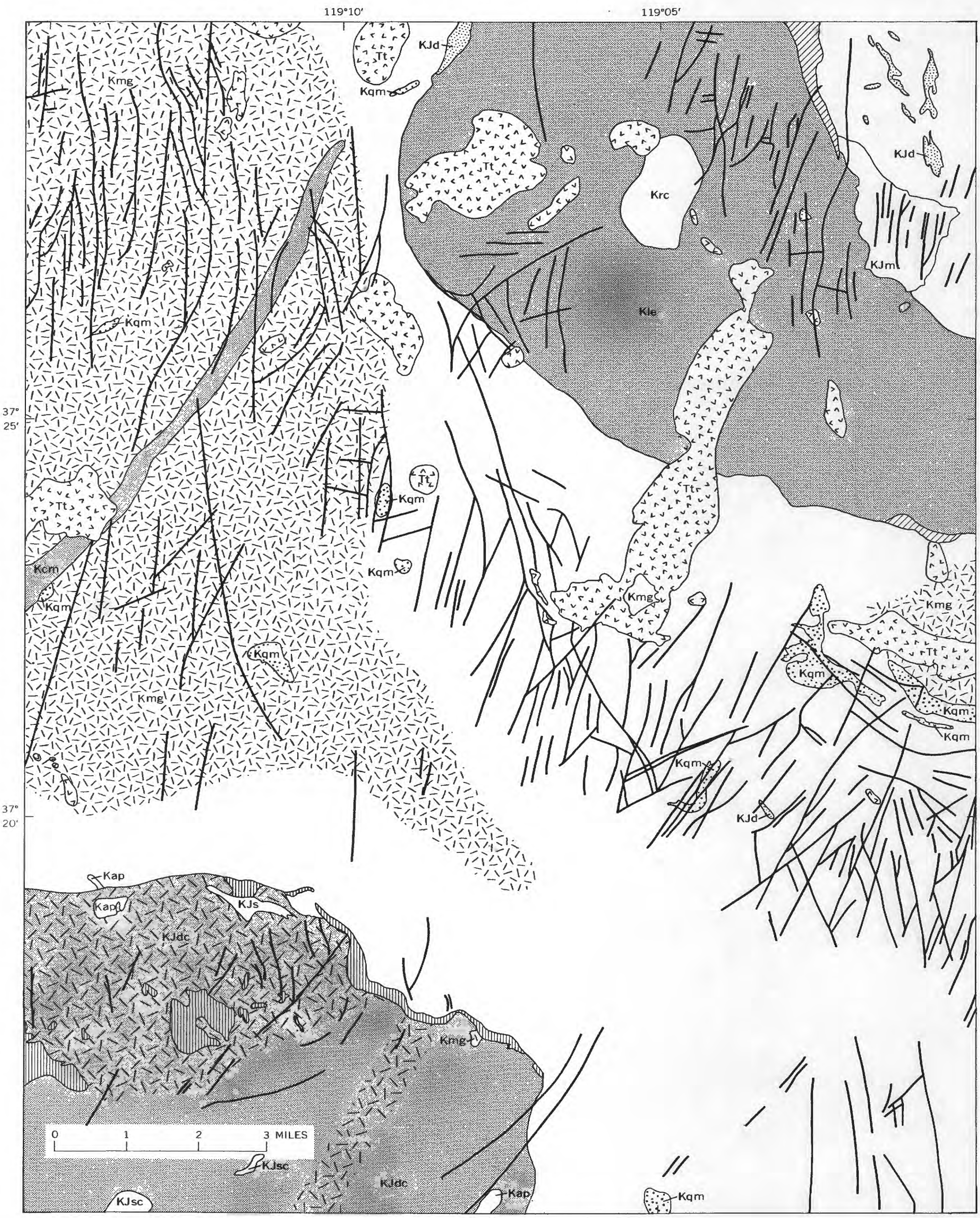

FIGURE 7.—Steeply dipping regional joints. Joints are not shown in areas covered by glacial deposits.

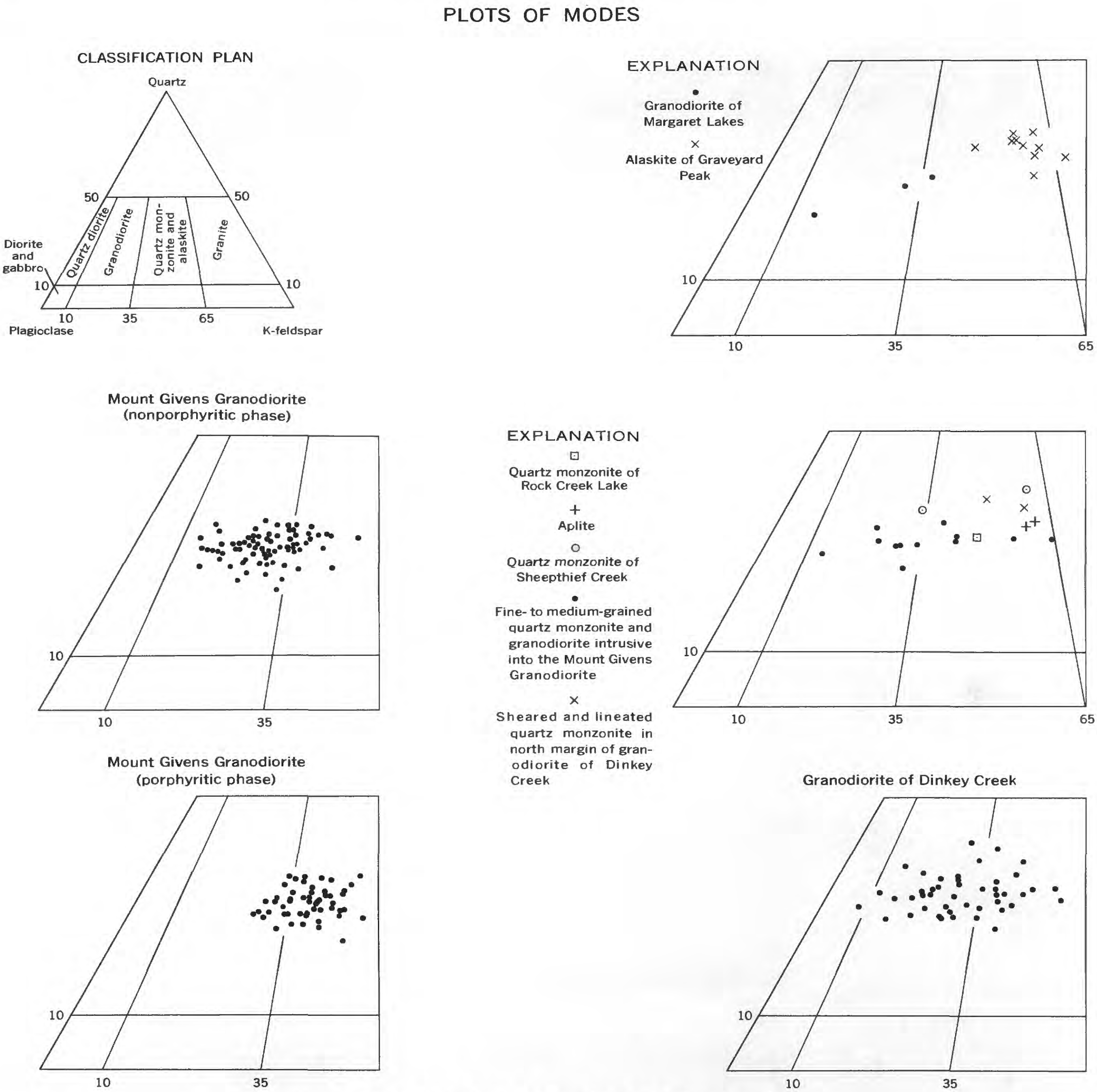

FIGURE 8.—Modes and norms of granitic and volcanic rocks.

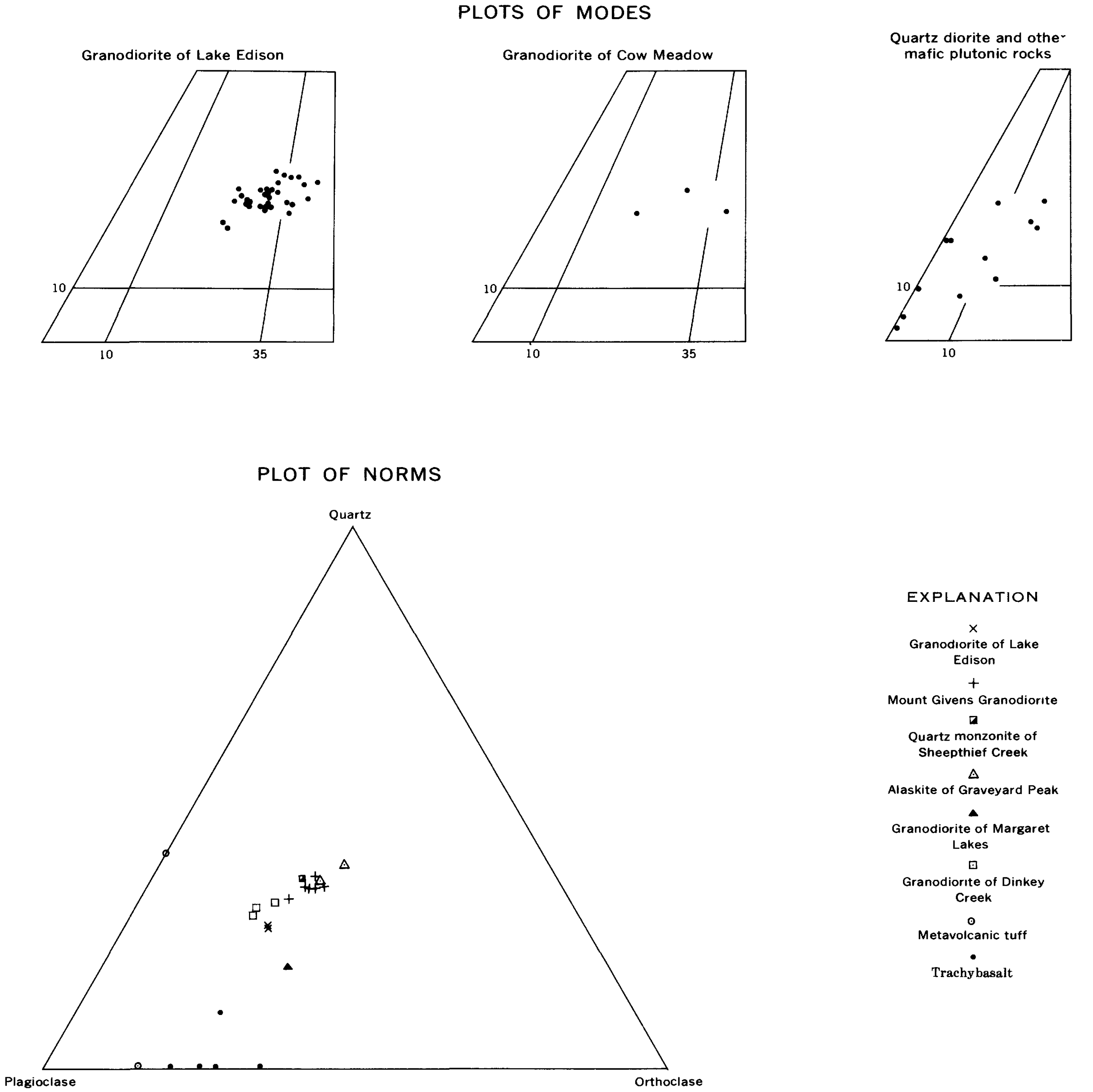

FIGURE 8.—Continued

TABLE 1.—*Chemical analyses, norms, and modes of rocks*

	Alaskite of Graveyard Peak		Granodiorite of Margaret Lakes	Granodiorite of Lake Edison		Mount Givens Granodiorite					
						Porphyritic			Equigranular		
	KPb–83	KPb–53	KPb–74	KPb–34	KPb–10	KPa–11	KPa–66	KPc–26	KPb–59	KPc–42	KPd–61
Chemical analyses (weight percent) [Analysts: For rapid rock analyses, Paul Elmore, Sam Botts, and Lowell Artis; for standard rock analyses (only sample KPc–138), George Riddle]											
SiO_2	76.3	76.6	64.6	67.3	66.9	72.8	71.8	71.2	68.2	70.4	71.1
Al_2O_3	13.4	12.9	16.4	16.2	15.5	14.7	14.7	14.8	15.5	15.1	14.4
Fe_2O_3	.21	.11	2.0	1.6	1.8	.51	.89	.98	1.2	1.2	1.1
FeO	.22	.22	2.6	1.5	2.0	.72	1.1	1.2	2.3	1.5	1.5
MgO	.1	.1	1.6	1.1	1.7	.5	1.1	.8	1.6	.6	1.0
CaO	.34	.42	2.4	3.4	3.4	1.7	1.9	2.1	3.3	2.5	2.4
Na_2O	4.3	3.5	4.0	3.6	3.5	3.6	3.2	3.2	2.9	3.1	2.8
K_2O	4.5	4.9	4.4	3.6	3.6	4.1	4.0	4.2	3.6	4.0	4.4
H_2O^-	.02	.03	.04	.13	.04	.06	.10	.14	.03	.05	.05
H_2O^+	.27	.96	.77	.60	.61	.60	.59	.76	.56	.82	.62
TiO_2	.11	.09	.68	.51	.48	.19	.34	.38	.47	.45	.38
P_2O_5	.00	.02	.20	.16	.16	.05	.08	.09	.11	.11	.08
MnO	.06	.02	.22	.06	.08	.04	.06	.04	.07	.05	.07
CO_2	.08	<.05	<.05	<.05	.10	<.05	.05	.05	.09	.08	<.05
Cl	------	------	------	------	------	------	------	------	------	------	------
F	------	------	------	------	------	------	------	------	------	------	------
Sum	100	100	100	100	100	100	100	100	100	100	100
Powder density (gm per cc)	2.64	2.64	2.76	2.73	2.74	2.66	2.68	2.69	2.74	2.72	2.72
Semiquantitative spectrographic analyses [Analyst: Marcelyn Cremer, except sample KPc–138 which was analyzed by A. L. Sutton, Jr. Looked for but not found: Ag, As, Au, Bi, Cd, Ge, Hf, Hg, In, Li, Mo, Pd, Pt, Re, Sb, Ta, Te, Th, Tl, U, W, Zn. Results reported in percent to the nearest number in the series 1, 0.7, 0.5, 0.3, 0.2, 0.15, and 0.1, etc., which represents approximate midpoints of group data on a geometric scale. The assigned group for semiquantitative results will include the quantitative value about 30 percent of the time]											
B	------	------	------	------	0.001	------	0.001	------	0.001	0.001	0.001
Ba	0.03	0.03	0.15	0.15	.1	0.15	.1	0.15	.1	.1	.07
Be	.0003	.00015	.0002	.00015	.0002	.0002	.0002	.0001	.00015	.00015	.0001
Ce	------	------	------	------	------	------	------	------	.015	------	------
Co	------	------	.001	.0007	.001	------	.0005	.0005	.001	.0007	.0007
Cr	.0003	------	.0005	.0005	.001	.0003	.0005	.0007	.0015	.001	.0007
Cu	.0007	.0001	.0005	.0015	.003	.0002	.00015	.0002	.0003	.0003	.00015
Ga	.0015	.001	.002	.0015	.0015	.0015	.0015	.0015	.0015	.0015	.0015
La	.003	.003	------	------	------	------	.005	------	.01	.005	------
Nb	.0015	.001	.001	.001	.001	------	.001	------	.001	.001	------
Nd	------	------	------	------	------	------	------	------	------	------	------
Ni	------	------	.0007	------	.001	------	------	.0005	.001	.0007	.0005
Pb	.002	.005	.002	.003	.005	.005	.005	.005	.005	.005	.005
Sc	------	------	.001	.0005	.0007	------	------	.0005	.001	.0005	.0007
Sr	.002	.002	.03	.05	.03	.02	.03	.02	.02	.03	.015
V	.0005	.0005	.01	.007	.01	.002	.003	.005	.01	.007	.007
Y	.003	.0015	.002	.0015	.002	.001	.0015	.0015	.002	.0015	.0015
Yb	.0003	.00015	.0002	.00015	.0002	.0001	.00015	.00015	.0002	.00015	.00015
Zr	.007	.007	.015	.015	.01	.01	.01	.01	.01	.015	.01
CIPW norms (weight percent)											
Q	33.34	36.41	16.44	23.79	22.97	31.62	32.15	30.83	27.48	30.83	30.95
C	1.02	1.12	1.17	.58	.28	1.37	1.96	1.50	1.31	1.57	.86
or	26.59	28.96	26.00	21.27	21.27	24.23	23.64	24.82	21.27	23.64	26.00
ab	36.39	29.62	33.85	30.46	29.62	30.46	27.08	27.08	24.54	26.23	23.69
an	1.18	1.95	10.60	15.82	15.19	8.11	8.59	9.51	15.08	11.18	11.38
ne	------	------	------	------	------	------	------	------	------	------	------
wo	------	------	------	------	------	------	------	------	------	------	------
en	.25	.25	3.99	2.74	4.23	1.25	2.74	1.99	3.99	1.49	2.49
fs	1.6	.20	2.41	.70	1.54	.66	.84	.84	2.59	1.11	1.35
fo	------	------	------	------	------	------	------	------	------	------	------
fa	------	------	------	------	------	------	------	------	------	------	------
mt	.30	.16	2.90	2.32	2.61	.74	1.29	1.42	1.74	1.74	1.60
hm	------	------	------	------	------	------	------	------	------	------	------
il	.21	.17	1.29	.97	.91	.36	.65	.72	.89	.86	.72
ap	------	.05	.47	.38	.38	.12	.19	.21	.26	.26	.19
cc	.18	------	------	------	.23	------	.11	.11	.21	.18	------
hl	------	------	------	------	------	------	------	------	------	------	------
fr	------	------	------	------	------	------	------	------	------	------	------
Total	99.62	98.89	99.12	99.03	99.23	98.92	99.24	99.03	99.36	99.09	99.23
Modes (volume percent) [Analysts: M. B. Norman and M. G. Hoerster. 1,000–2,000 point counts on a stained slab of at least 6-square-inch area]											
Quartz	36.8	29.3	19.9	24.8	24.9	30.5	33.4	30.6	26.9	30.4	29.0
K-feldspar	37.9	42.2	11.0	20.7	20.4	29.1	23.2	26.6	21.3	22.0	27.4
Plagioclase	24.5	27.9	59.6	45.2	42.4	38.1	37.5	35.9	38.4	39.2	35.1
Mafic minerals	.8	.6	9.5	9.3	12.3	2.3	5.9	6.9	13.4	8.4	8.5
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

TABLE 1.—*Chemical analyses, norms, and modes of rocks*—Continued

Granodiorite of Dinkey Creek			Quartz monzonite of Sheepthief Creek	Metavolcanic tuff		Trachybasalt and related volcanic rocks				
KPc–30	KPc–138	KPc–9	KPc–1	KPb–39	KPb–37	KPa–85	KPb–18	KPa–52	KPb–14	KPb–1
Chemical analyses (weight percent) [Analysts: For rapid rock analyses, Paul Elmore, Sam Botts, and Lowell Artis; for standard rock analyses (only sample KPc–138), George Riddle]										
68.6	70.64	67.0	72.1	67.1	51.9	50.6	48.7	54.4	54.4	54.7
15.5	14.74	15.7	14.6	14.7	17.6	16.2	15.9	14.7	15.9	15.3
.84	.73	1.2	.75	2.9	3.6	.37	3.0	6.1	2.8	4.0
2.6	2.27	2.7	1.5	1.6	4.9	7.3	5.1	2.4	4.3	2.2
.9	.80	1.4	.5	1.0	5.9	9.2	9.8	5.4	7.1	7.2
3.1	2.66	3.6	2.1	7.8	7.4	7.7	8.4	6.8	6.3	6.0
3.7	3.71	3.4	3.3	2.8	4.0	3.9	3.5	3.2	3.6	3.5
3.0	3.42	3.0	3.8	.05	1.8	2.1	2.5	2.7	2.8	4.0
.20	.01	.11	.06	.28	.17	.05	.19	.74	.34	.09
.60	.41	.89	.70	.66	1.1	.41	.69	1.1	.56	.41
.55	.37	.63	.32	.62	1.1	1.4	1.4	1.4	.97	1.0
.11	.10	.11	.05	.19	.34	.57	.00	.56	.59	.67
.06	.07	.07	.05	.13	.21	.15	.14	.12	.12	.09
.05	.01	<.05	<.05	<.05	<.05	<.05	.09	.09	.08	.12
------	.04	------	------	------	------	------	------	------	------	------
------	.06	------	------	------	------	------	------	------	------	------
100	100.04	100	100	100	100	100	99	100	100	99
2.72	2.70	2.74	2.68	2.83	2.92	2.99	3.02	2.90	2.90	2.91
Semiquantitative spectrographic analyses [Analyst: Marcelyn Cremer, except sample KPc–138 which was analyzed by A. L. Sutton, Jr. Looked for but not found: Ag, As, Au, Bi, Cd, Ge, Hf, Hg, In, Li, Mo, Pd, Pt, Re, Sb, Ta, Te, Th, Ti, U, W, Zn. Results reported in percent to the nearest number in the series 1, 0.7, 0.5, 0.3, 02., 0.15, and 0.1, etc., which represents approximate midpoints of group data on a geometric scale. The assigned group for semiquantitative results will include the quantitative value about 30 percent of the time]										
------	------	------	------	0.001	------	------	------	0.001	0.001	------
0.07	0.07	0.07	0.15	.015	0.07	0.15	0.2	.15	.2	0.3
.00015	------	.00015	.00015	.00015	------	.00015	.0002	.00015	.00015	.0002
------	------	------	------	------	------	------	------	------	------	.015
.001	.0007	.001	.0005	.001	.003	.005	.005	.003	.003	.003
.0007	.0007	.001	.0005	.005	.015	.07	.07	.05	.05	.05
.0003	.0005	.0003	.0001	.00015	.0007	.005	.005	.005	.005	.005
.0015	.003	.0015	.0015	.0015	<.002	<.002	<.002	<.002	.0015	.0015
.005	------	.005	.005	.003	------	.007	.01	.005	.005	.01
.001	.001	.001	------	.001	.001	.0015	.0015	.0015	------	------
------	------	------	------	------	------	------	.015	------	------	.015
.0007	------	.0007	------	.002	.01	.05	.05	.015	.02	.05
.003	.002	.003	.003	.003	.005	.003	.002	.003	.005	.005
.001	.0005	.001	.0007	.0015	.003	.003	.003	.003	.002	.002
.02	.05	.02	.015	.03	.05	.1	.1	.07	.1	.15
.007	.007	.01	.003	.01	.05	.05	.05	.03	.03	.03
.003	.0015	.003	.002	.003	.005	.003	.003	.003	.003	.002
.0003	.0002	.0003	.0002	.0003	.0005	.0003	.0003	.0003	.0003	.0002
.015	.007	.015	.01	.015	.015	.02	.02	.015	.015	.02
CIPW norms (weight percent)										
26.57	28.36	24.86	32.49	35.13	------	------	------	7.19	0.35	------
.91	.57	.58	1.36	------	------	------	------	------	------	------
17.73	20.20	17.73	22.46	.30	10.64	12.41	14.77	15.96	16.55	23 64
31.31	31.09	28.77	27.92	23.69	33.85	26.72	18.41	27.08	30.46	29.62
14.34	12.07	17.14	10.09	27.39	24.75	20.50	20.29	17.77	18.96	14.22
------	------	------	------	------	------	3.40	6.07	------	------	------
------	------	------	------	4.20	4.07	5.84	8.69	4.90	3.32	4.35
2.24	1.99	3.49	1.25	2.49	9.47	3.69	6.53	13.45	17.68	17.64
3.28	3.08	3.06	1.70	------	2.96	1.78	1.29	------	4.20	------
------	------	------	------	------	3.67	13.47	12.53	------	------	.21
------	------	------	------	------	1.26	7.17	2.74	------	------	------
1.22	1.06	1.74	1.09	3.78	5.22	.54	4.35	4.07	4.06	4.49
------	------	------	------	.29	------	------	------	3.29	------	.91
1.05	.70	1.20	.61	1.18	2.09	2.66	2.66	2.66	1.84	1.90
.26	.24	.26	.12	.45	.81	1.35	------	1.33	1.40	1.59
.11	.02	------	------	------	------	------	.21	.21	.18	.27
------	.07	------	------	------	------	------	------	------	------	------
------	.11	------	------	------	------	------	------	------	------	------
99.02	99.56	98.83	99.09	98.90	98.79	99.53	98.54	97.91	99.00	98.84
Modes (volume percent) [Analysts: M. B. Norman and M. G. Hoerster. 1,000–2,000 point counts on a stained slab of at least 6-square-inch area]										
27.7	31.3	27.8	32.7	------	------	------	------	------	------	------
12.8	18.4	12.7	20.0	------	------	------	------	------	------	------
45.3	41.3	44.7	38.6	------	------	------	------	------	------	------
14.2	9.0	14.8	8.7	------	------	------	------	------	------	------
100.0	100.0	100.0	100.0	------	------	------	------	------	------	------

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