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Title of article Petrology and Geochemistry of the Beemerville Carbonatite-Alkaline Rock Complex, New Jersey

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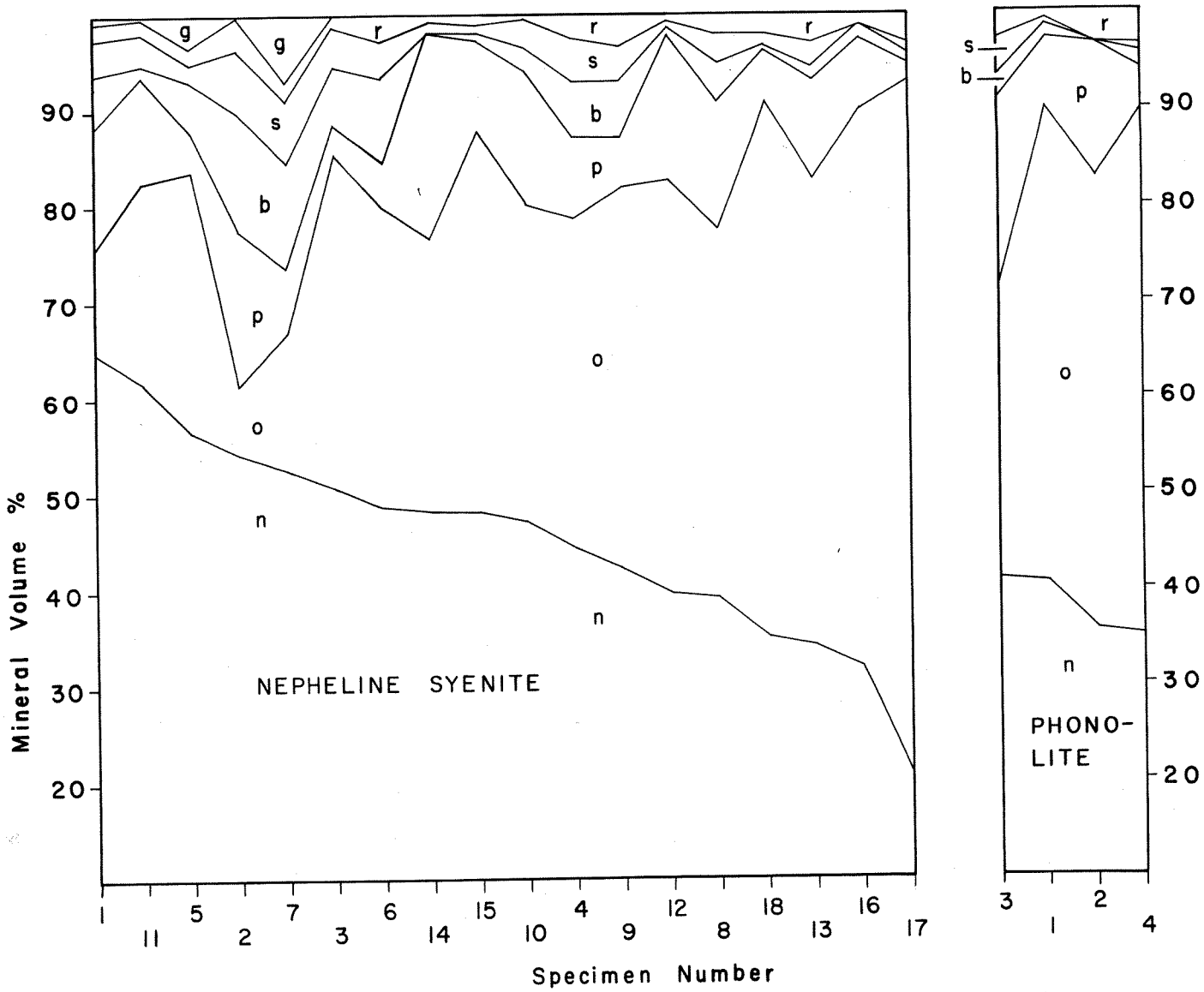
APPENDIX I

Petrology and Geochemistry of the Beemerville Carbonatite-Alkaline Rock Complex, New Jersey

Lawrence R. Maxey

CAPTION FOR FIGURE 1 IN APPENDIX I

Figure 1. Modal analyses of massive nepheline syenite and included phonolite dikes; (n) nepheline + cancrinite + sodalite; (o) orthoclase; (p) clinopyroxene; (b) biotite; (s) sphene; (g) melanite; (r) remainder, almost entirely magnetite and apatite. Abcissa sample numbers correspond to chemical analyses numbers of Tables 5 and 6A of Appendix I.


Mineral Volume %
90
80
70
60
50
40
30
20
g
g
r
r
r
s
s
b
b
p
p
o
o
n
n
NEPHELINE SYENITE
1
11
5
2
7
3
6
14
15
10
4
9
12
8
18
13
16
17
Specimen Number
s
b
r
p
o
n
PHONO-
LITE
3
1
2
4

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APPENDIX TABLE 1. CHEMICAL ANALYSES OF MASSIVE NEPHELINE SYENITE

	1	2	3	4	5	6	7	8	9	10	11
SiO_2	44.76	44.83	46.34	47.32	48.20	48.22	48.44	50.21	50.42	50.87	52.64
Al_2O_3	21.96	20.77	21.48	21.77	22.34	21.91	21.92	21.38	21.80	21.02	21.38
Fe_2O_3 (1)	7.38	8.13	5.06	7.03	4.43	5.95	5.57	6.58	6.00	5.57	5.15
MgO	1.85	1.69	1.44	1.04	0.81	1.27	1.27	1.13	0.90	1.06	0.78
CaO	6.89	6.47	4.62	3.58	2.97	2.77	3.70	2.93	2.17	3.43	1.93
Na_2O	8.67	8.55	8.83	7.88	9.31	7.95	8.05	7.55	6.68	7.97	7.15
K_2O	6.15	6.39	7.87	8.64	9.04	9.49	8.64	8.53	10.06	7.99	9.49
TiO_2	2.28	2.40	2.20	1.89	1.07	2.10	2.29	1.48	1.79	1.50	0.82
MnO	0.24	0.25	0.17	0.23	0.13	0.18	0.19	0.27	0.13	0.22	0.17
CO_2	0.08	0.59	0.08	0.37	0.75	0.49	0.30	0.51	0.13	0.20	0.31
TOTAL	100.26	100.07	98.09	99.75	99.05	100.33	100.07	100.57	100.08	99.83	99.82

APPENDIX TABLE 1. (continued)

	12	13	14	15	16	17	18	19
SiO_2	52.84	53.66	53.82	54.82	54.92	55.68	55.87	47.19
Al_2O_3	21.07	20.40	20.78	21.34	20.26	20.93	20.50	23.01
Fe_2O_3 (1)	4.63	4.66	5.13	4.43	6.45	5.00	4.13	5.59 (2)
MgO	0.38	0.57	0.43	0.36	0.33	0.54	0.28	1.07
CaO	2.13	1.98	2.25	1.59	1.59	0.82	0.74	2.93
Na_2O	8.17	4.98	7.90	7.92	6.94	5.74	5.00	7.97
K_2O	9.21	10.87	8.31	8.63	8.76	10.94	11.53	8.23
TiO_2	0.54	0.72	0.65	0.63	1.08	0.60	0.45	2.16
MnO	0.18	0.13	0.22	0.20	0.23	0.20	0.09	0.16
CO_2	0.47	0.23	0.74	0.61	0.37	0.40	0.39	0.38
TOTAL	99.62	98.20	100.23	100.53	100.93	100.85	98.98	99.67 (3)

(1) Total Fe as Fe_2O_3 (2) Fe_2O_3 = 3.11, FeO = 2.23 (3) Includes H_2O = 0.59, P_2O_5 = 0.39

Chemical analyses 12, 14, 15, and 16 are of specimens from the northernmost body. The remaining chemical analyses are of specimens from the southernmost body except for analysis no. 19 made by Aurousseau (Aurousseau and Washington, 1922). with location unspecified.

APPX. TABLE 2A. CHEMICAL ANALYSES OF PHONOLITE DIKES IN NEPHELINE SYENITE

	1	2	3	4
SiO_2	55.92	52.26	51.12	53.93
Al_2O_3	22.14	20.51	20.99	19.89
Fe_2O_3(1)	3.59	4.99	5.95	5.38
MgO	0.28	0.36	0.79	0.48
CaO	0.26	2.20	3.62	1.70
Na_2O	6.46	7.38	7.92	6.25
K_2O	11.50	9.31	8.11	10.08
TiO_2	0.35	0.47	1.26	0.61
MnO	0.09	0.19	0.23	0.19
CO_2	0.25	0.13	0.57	0.46
TOTAL	100.84	97.80	100.56	98.97

(1) Total Fe as Fe_2O_3

APPX. TABLE 2B. CHEMICAL ANALYSES OF INTENSELY ALTERED PHONOLITE INTRUSIONS IN THE MARTINSBURG FORMATION AND DIATREMES

	1	2	3	4	5	6
SiO_2	58.78	47.31	52.95	57.89	55.81	49.07
Al_2O_3	19.97	20.79	19.41	19.28	18.20	18.66
Fe_2O_3 (1)	4.22	5.40	4.63	5.52	5.43	7.11
MgO	0.78	0.67	0.50	0.21	0.45	1.08
CaO	2.51	5.28	3.42	2.15	3.53	6.34
Na_2O	6.33	4.02	4.14	1.99	4.79	4.19
K_2O	4.28	5.48	7.40	10.30	7.31	4.56
TiO_2	0.51	0.86	0.26	0.41	0.40	1.17
MnO	0.12	0.38	0.41	0.32	0.35	0.30
CO_2	1.91	4.68	2.63	2.58	3.16	3.96
TOTAL	99.41	94.87	95.75	100.55	99.43	96.44

	7	8	9	10	11	12
SiO_2	45.20	47.66	46.14	49.45	50.08	51.43
Al_2O_3	17.19	17.20	16.95	23.65	21.17	20.53
Fe_2O_3 (1)	6.73	4.97	6.83	6.79	6.55	4.88
MgO	1.38	1.94	2.34	1.59	1.47	0.41
CaO	8.58	8.00	9.25	1.24	2.47	4.17
Na_2O	0.38	0.25	0.34	0.10	0.18	2.87
K_2O	9.75	11.36	8.66	12.02	12.32	8.76
TiO_2	1.26	1.33	1.27	0.62	0.53	0.45
MnO	0.36	0.36	0.39	0.08	0.11	0.31
CO_2	6.47	5.85	6.04	1.10	1.96	4.08
TOTAL	97.30	98.92	98.21	96.64	96.84	97.89

(1) Total Fe as Fe_2O_3

APPX. TABLE 2B (CONTINUED)

	13	14	15	16	17	18	19
SiO_2	57.57	58.16	55.83	57.70	47.00	56.46	55.54
Al_2O_3	16.96	21.57	24.42	20.53	19.46	20.22	18.35
Fe_2O_3(1)	7.73	4.16	5.29	3.59	5.71	6.08	3.27
MgO	0.75	0.18	0.27	0.27	0.72	1.23	0.44
CaO	7.71	0.19	0.11	0.22	8.85	2.18	4.61
Na_2O	6.65	4.46	3.69	9.25	4.60	5.97	8.33
K_2O	1.72	8.29	8.42	1.28	4.15	3.92	1.16
TiO_2	0.64	0.38	0.28	0.29	0.54	0.59	0.30
MnO	0.34	0.26	0.24	0.06	0.52	0.18	0.36
CO_2	1.08	0.57	0.53	1.28	7.55	1.69	4.05
TOTAL	101.15	98.22	99.08	94.47	100.10	98.52	96.41

	20	21	22	23	24	25	26
SiO_2	56.02	48.42	52.90	52.01	56.02	48.97	54.95
Al_2O_3	21.16	19.25	16.13	20.32	19.16	21.81	19.66
Fe_2O_3(1)	3.60	3.33	4.91	3.79	2.40	4.45	6.95
MgO	0.37	0.32	0.78	0.31	0.49	0.25	0.74
CaO	3.32	7.57	5.20	5.22	3.05	4.23	2.84
Na_2O	5.48	3.03	2.29	2.85	5.62	1.92	3.21
K_2O	5.25	7.93	9.42	8.50	5.95	10.10	7.78
TiO_2	0.43	0.41	0.47	0.39	0.41	0.41	0.95
MnO	0.33	0.50	0.34	0.38	0.22	0.45	0.24
CO_2	3.00	6.71	4.36	5.31	2.76	4.34	2.14
TOTAL	98.96	97.47	96.80	99.08	96.08	96.93	99.46

(1) Total Fe as Fe_2O_3

APPX. TABLE 2B (CONTINUED)

	27	28	29	30	31
SiO_2	58.18	55.74	53.87	56.02	55.44
Al_2O_3	21.37	20.71	19.82	19.82	22.66
Fe_2O_3 (1)	3.45	8.06	3.68	3.97	3.86
MgO	0.72	1.97	0.55	0.52	0.91
CaO	0.22	1.65	3.54	2.48	1.14
Na_2O	7.83	6.68	3.06	2.96	1.90
K_2O	3.02	1.71	8.85	9.44	10.56
TiO_2	0.36	0.27	0.25	0.29	0.31
MnO	0.06	0.11	0.26	0.30	0.24
CO_2	1.27	2.38	3.32	1.95	1.42
TOTAL	96.48	99.28	97.20	97.79	98.44

(1) Total Fe as Fe_2O_3

APPENDIX TABLE 3. CHEMICAL ANALYSES OF TINGUAITE INTRUSIONS

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
SiO_2	47.35	50.68	52.29	54.62	54.04	56.92	51.76	54.14	48.20	47.62	51.49	54.21	49.96	47.52
Al_2O_3	21.17	21.07	20.01	19.19	17.69	13.80	19.28	20.19	21.16	20.68	19.57	19.35	19.23	18.61
Fe_2O_3 (1)	7.05	6.19	5.98	7.10	8.14	10.90	6.93	3.93	6.53	6.18	5.97	4.81	7.06 (2)	7.01 (4)
MgO	1.24	0.81	0.56	0.41	0.34	0.13	0.70	0.19	1.17	1.20	0.46	0.37	1.23	1.41
CaO	4.89	3.56	2.03	1.88	1.92	1.49	3.16	2.65	4.44	4.79	3.82	2.24	4.15	4.82
Na_2O	9.40	8.92	9.40	8.49	9.42	6.21	8.71	8.76	8.24	7.47	8.79	8.18	8.08	7.78
K_2O	6.78	7.75	8.36	7.17	7.11	6.38	7.84	6.90	6.39	6.97	6.39	6.68	7.01	5.44
TiO_2	1.99	1.43	0.98	0.46	0.69	1.04	1.18	0.27	1.75	1.65	0.48	0.46	1.51	3.61
MnO	0.23	0.26	0.27	0.26	0.43	0.50	0.28	0.40	0.25	0.23	0.40	0.35	0.17	0.15
CO_2	0.14	0.12	0.80	0.28	0.81	0.31	0.42	2.70	1.00	0.97	0.55	1.60	0.12	0.17
TOTAL	100.24	100.79	100.68	99.86	100.59	97.68	100.36	100.13	99.13	97.76	97.92	98.25	99.50 (3)	99.50 (5)

(1) Total Fe as Fe_2O_3 (2) Fe_2O_3 = 4.55, FeO = 2.26 (3) Includes H_2O = 0.44, P_2O_5 = 0.54

(4) Fe_2O_3 = 5.52, FeO = 1.34 (5) Includes H_2O = 2.71, P_2O_5 = 0.27

1-5. Tinguaite dikes in massive nepheline syenite. 6-12. Tinguaite intrusions in Martinsburg Formation. 13. Complete chemical analysis of tinguaite dike in massive nepheline syenite by Aurousseau (Aurousseau and Washington, 1922). 14. Complete chemical analysis of tinguaite dike in Martinsburg Formation by Milton (1952). Analyses 9 and 14 are of the same intrusion.

APPENDIX TABLE 4. CHEMICAL ANALYSES OF LAMPROPHYRE DIKES

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
SiO_2	45.19	45.74	39.71	42.35	39.04	38.24	34.24	35.27	42.43	38.53	40.62	38.49	37.62	41.11
Al_2O_3	15.32	15.50	13.62	13.81	13.24	11.59	9.85	10.77	13.83	12.26	14.16	13.40	12.78	12.76
Fe_2O_3 (1)	10.98	10.19	12.61	10.47	13.16	14.59	16.97	14.13	10.66	15.54	13.91 (2)	15.60	14.17	16.77
MgO	3.03	2.78	3.89	3.58	4.27	5.77	6.26	6.22	4.13	6.16	5.59	5.89	4.22	6.12
CaO	10.09	8.90	11.45	11.56	11.95	13.13	15.22	12.48	10.54	11.13	10.19	8.15	19.22	15.09
Na_2O	4.14	5.85	4.96	6.96	4.52	2.74	0.76	0.69	3.04	2.55	3.67	0.66	1.18	0.81
K_2O	5.25	4.67	4.27	2.70	3.25	3.02	3.22	5.69	3.72	3.77	3.05	2.50	1.94	2.93
TiO_2	4.21	3.92	4.47	4.24	4.40	4.62	5.41	4.68	3.55	4.51	4.80	5.79	3.65	4.56
MnO	0.26	0.29	0.30	0.27	0.27	0.24	0.26	0.21	0.21	0.24	0.17	0.16	0.33	0.40
CO_2	0.92	0.64	1.53	4.03	1.54	1.54	1.96	5.31	7.38	1.64	0.51	2.12	5.04	0.05
TOTAL	99.39	98.48	96.81	99.97	95.64	95.48	94.15	95.45	99.49	96.33	100.46 (3)	92.76	100.15	100.60

(1) Total Fe as Fe_2O_3 (2) Fe_2O_3 = 7.06, FeO = 6.16 (3) Includes H_2O = 2.75, P_2O_5 = 1.04

1-2. Little-altered micromalignite dikes. 3. Highly-altered micromalignite specimen from same dike as analysis 2. 4. Little-altered micromelteigite dike. 5-10. Highly-altered, thicker lamprophyre dikes. 11. Complete chemical analysis by Milton (1952) of same dike as analysis 10. 12-14. Extremely fine-grained lamprophyre dikes. Dike of analysis 13 cuts small, carbonatite intrusion.

APPENDIX TABLE 5. MODES OF LAMPROPHYRE MICROMELTEIGITE AUTOLITHS IN THE RUTAN HILL DIATREME

Nepheline[1]	28.2	11.6	33.4	19.4	26.9	25.8	27.0
Clinopyroxene	37.4	56.8	25.4	46.4	35.6	52.8	51.8
Melanite	22.0	10.2	22.6	13.4	27.2	----	----
Sphene	tr	tr	0.2	tr	----	10.2	9.6
Biotite	1.8	9.6	8.4	5.6	0.6	tr	0.2
Apatite	4.8	6.2	5.4	8.6	5.8	5.6	4.8
Opaques[2]	5.8	4.6	1.6	6.2	3.9	5.2	5.2
Calcite	tr	1.0	3.0	0.4	---	0.4	1.4
TOTAL	100.0	100.0	100.0	100.0	100.0	100.0	100.0

(1) Completely replaced by muscovite. (2) Magnetite plus trace (tr) pyrite.

Modal analyses 1 and 2 correspond to chemical analyses 6 and 7 of Table 6.

APPENDIX TABLE 6. CHEMICAL ANALYSES OF SILICOCARBONATITE INTRUSION AND DIATREME ROCKS

	1	2	3	4	5	6	7	8	9	10	11	12	13
SiO_2	21.77	21.98	29.77	32.34	14.87	37.48	39.74	41.10	36.81	34.63	55.34	54.61	61.80
Al_2O_3	7.96	6.62	7.81	9.72	6.28	12.89	9.48	9.60	7.87	10.21	18.92	19.89	12.35
Fe_2O_3 (1)	14.71	11.64	10.64	14.94	14.73(2)	14.07	16.36	15.05	10.99	12.56	7.92	3.80	7.01
MgO	5.30	2.74	2.69	3.96	3.53	4.09	6.00	5.67	4.36	3.50	1.54	0.36	2.57
CaO	24.68	30.25	22.37	15.99	29.78	20.89	18.80	18.28	20.93	17.96	0.08	2.82	3.40
Na_2O	1.80	0.85	1.95	2.33	2.40	1.09	0.68	0.51	0.14	2.88	3.31	7.42	9.69
K_2O	2.42	2.49	2.95	3.95	2.12	3.50	1.69	2.49	1.71	3.06	8.95	7.55	0.51
TiO_2	1.70	1.89	1.75	2.83	2.44	3.14	3.99	3.10	1.79	2.87	0.94	0.50	1.03
MnO	0.51	0.40	0.39	0.25	0.25	0.30	0.35	0.33	0.40	0.33	0.04	0.15	0.12
CO_2	18.41	20.47	18.36	11.42	21.28	2.15	1.73	1.67	14.01	10.83	0.39	2.00	0.44
TOTAL	99.26	99.33	98.68	97.73	101.16(3)	99.60	98.82	97.80	99.01	98.83	97.43	99.10	98.92

(1) Total Fe as Fe_2O_3 (2) Fe_2O_3 = 5.68, FeO = 8.14 (3) Includes H_2O = 1.10, P_2O_5 = 2.38.

1. Biotite sovite intrusion in fractured Martinsburg Formation near small diatreme. 2-4. Silicocarbonatite autoliths at Rutan Hill. 5. Silicocarbonatite autolith at Rutan Hill analyzed by Milton (1952). 6-7. Garnet lamprophyre micromelteigite autoliths at Rutan Hill. Correspond to modes 1 and 2 of Table 5. 8-9. Relatively uncontaminated diatreme matrix rock at small diatremes. Diatreme matrix rock of analysis 8 contains considerable melanite. 10. Relatively uncontaminated matrix rock at Rutan Hill. 11. Least-altered syenite autolith obtainable at Rutan Hill. 12. Small intrusive body of nepheline syenite at Rutan Hill. 13. Fenitized Martinsburg graywacke.