University of Wisconsin-Extension

GEOLOGICAL AND NATURAL HISTORY SURVEY
3817 Mineral Point Road
Madison, Wisconsin 53705

M.E. Ostrom, State Geologist and Director

ANAYTICAL DATA OF PRECAMBRIAN GRANITIC ROCK FROM NORTHEASTERN WISCONSIN

by

Gregory Mursky and William Bailey

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Gregory Mursky[1] and William Bailey[1]

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ABSTRACT

Precambrian granitic rock from northeastern Wisconsin appears to have been emplaced mesozonally between 1.6 and 1.9 Ga. Granite to quartz diorite are represented, yet mineralogy is quite similar. The rock is calc-alkalic in nature and displays a relatively high K_2O/Na_2O ratio which supports a syntectonic to late tectonic origin.

The close correlation between the results of this study and experimental results for the system Ab-Q-Or-H_2O and Ab-An-Or-H_2O imply that the granitic rock has formed through crystallization of a magma derived from the melting of downfolded crustal rock, possibly along a subducting zone. Most rock units appear to have formed between 670 °C and 750 °C and from 1 to 3 Kbar pressure.

INTRODUCTION

The main purpose of this study is to provide information, primarily of a petrological and chemical nature, about granitic rock from a twenty thousand square kilometer area in northeastern Wisconsin. Because of the enormous size of the area and the relative scarcity of outcrop detailed fieldwork was not attempted. It is hoped, however, that much of the information presented here will be of use to future investigators involved with more detailed studies. The commentary on the data are published separately (Mursky and Bailey, 1988) in Geoscience Wisconsin Volume 12.

METHODS

Eighty thin sections were made, at least one for each outcrop. The anorthite content of plagioclase was determined with the aid of four axis Zeiss universal stage according to Michel-Levy method. Modal analyses were obtained from rock slabs after staining of feldspar according to the method of Bailey and Stevens (1960) and Hutchison (1974). Whole rock chemical analyses for Si, Al, K, Ca, and Fe were determined using a Phillips PW 1410 X-ray spectrometer

[1]Department of Geological and Geophysical Sciences, University of Wisconsin-Milwaukee, Milwaukee, Wisconsin 53201

(XRF) whereas Na and Mg were determined by atomic absorption. X-ray spectrometry (XRF) was carried out according to the procedure described by Jenkins (1976) and atomic absorption techniques were similar to those advanced by Angino and Billings (1972).

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Bailey, E.H. and Stevens, R.E., 1960, Selective staining of K-feldspar and plagioclase on rock slabs and thin sections: American Mineralogist, v. 45, p. 1020-1025.

Hutchison, C.S., 1974, Laboratory handbook of petrographic techniques, New York, John Wiley and Sons, 527 p.

Mursky, Gregory, and Bailey, William, 1988, Petrochemistry of Precambrian granitic rock from northeastern Wisconsin: Geoscience Wisconsin Volume 12, p. 45-61.

Appendix 1. Sample locations

Sample Number	Location
1-1	NE1/4, NE1/4, sec. 13, T. 31 N., R. 7 E.
1-2	NE1/4, NW1/4, sec. 13, T. 31 N., R. 7 E.
1-3	SE1/4, NW1/4, sec. 30, T. 31 N., R. 10 E.
1-4	NW1/4, NE1/4, sec. 25, T. 31 N., R. 9 E.
2-1	NE1/4, SE1/4, sec. 1, T. 31 N., R. 10 E.
2-2	SW1/4, NE1/4, sec. 9, T. 31 N., R. 10 E.
2-3	SW1/4, SW1/4, sec. 15, T. 31 N., R. 10 E.
2-4	SW1/4, SW1/4, sec. 24, T. 31 N., R. 10 E.
2-5	SE1/4, SW1/4, sec. 6, T. 32 N., R. 6 E.
3-1	NW1/4, SW1/4, sec. 31, T. 33 N., R. 6 E.
4-2	SW1/4, SE1/4, sec. 30, T. 33 N., R. 6 E.
4-3	SW1/4, SW1/4, sec. 20, T. 32 N., R. 8 E.
4-4	NW1/4, SW1/4, sec. 16, T. 32 N., R. 8 E.
5-1	NE1/4, SW1/4, sec. 13, T. 32 N., R. 7 E.
5-2	NW1/4, SE1/4, sec. 18, T. 36 N., R. 9 E.
5-3	SW1/4, SW1/4, sec. 26, T. 36 N., R. 9 E.
5-4	SW1/4, SE1/4, sec. 32, T. 37 N., R. 9 E.
6-1	SE1/4, SE1/4, sec. 16, T. 38 N., R. 9 E.
6-2	NE1/4, NW1/4, sec. 6, T. 39 N., R. 10 E.
6-3	SW1/4, SE1/4, sec. 35, T. 41 N., R. 13 E.
6-4	NE1/4, SE1/4, sec. 11, T. 37 N., R. 13 E.
7-2	SW1/4, SW1/4, sec. 25, T. 37 N., R. 14 E.
7-3	NW1/4, NW1/4, sec. 31, T. 38 N., R. 12 E.
7-4	SW1/4, NE1/4, sec. 25, T. 38 N., R. 11 E.
7-5	NW1/4, NW1/4, sec. 29, T. 37 N., R. 12 E.
8-1	SE1/4, SW1/4, sec. 21, T. 37 N., R. 11 E.
8-2	SE1/4, SW1/4, sec. 33, T. 34 N., R. 15 E.
8-3	NW1/4, SW1/4, sec. 4, T. 35 N., R. 16 E.
8-4	SE1/4, SE1/4, sec. 18, T. 38 N., R. 16 E.
8-5	NW1/4, SW1/4, sec. 20, T. 38 N., R. 16 E.
9-1	SE1/4, SE1/4, sec. 19, T. 38 N., R. 16 E.
9-2	NE1/4, SE1/4, sec. 35, T. 37 N., R. 16 E.
9-3	NE1/4, NE1/4, sec. 15, T. 35 N., R. 17 E.
9-4	NW1/4, NW1/4, sec. 14, T. 35 N., R. 17 E.
9-5	NW1/4, NE1/4, sec. 19, T. 35 N., R. 18 E.
10-1	NW1/4, NW1/4, sec. 31, T. 34 N., R. 18 E.
10-2	NE1/4, NW1/4, sec. 28, T. 34 N., R. 18 E.
10-5	SE1/4, NE1/4, sec. 22, T. 34 N., R. 18 E.
10-7	SE1/4, NW1/4, sec. 15, T. 34 N., R. 18 E.
10-8	NE1/4, NW1/4, sec. 15, T. 34 N., R. 18 E.
11-1	SW1/4, SW1/4, sec. 11, T. 34 N., R. 18 E.
11-2	SE1/4, SE1/4, sec. 11, T. 34 N., R. 18 E.
11-3	NE1/4, NE1/4, sec. 11, T. 34 N., R. 18 E.
11-4	NW1/4, NW1/4, sec. 2, T. 34 N., R. 18 E.
11-5	NE1/4, SW1/4, sec. 34, T. 34 N., R. 18 E.
12-1	NW1/4, SE1/4, sec. 30, T. 34 N., R. 19 E.
12-2	SW1/4, SW1/4, sec. 5, T. 34 N., R. 19 E.
12-3	NW1/4, NW1/4, sec. 9, T. 34 N., R. 19 E.
12-4	SW1/4, SE1/4, sec. 7, T. 34 N., R. 19 E.
12-5	SE1/4, SE1/4, sec. 24, T. 34 N., R. 18 E.

12-6	SW1/4, SW1/4, sec. 19, T. 34 N., R. 19 E.
13-1	SW1/4, SE1/4, sec. 19, T. 34 N., R. 19 E.
13-2	NE1/4, SW1/4, sec. 15, T. 34 N., R. 19 E.
13-3	SW1/4, SW1/4, sec. 10, T. 34 N., R. 19 E.
13-4	SE1/4, NW1/4, sec. 20, T. 35 N., R. 20 E.
13-5	SW1/4, NE1/4, sec. 19, T. 35 N., R. 20 E.
14-1	SW1/4, NW1/4, sec. 16, T. 33 N., R. 18 E.
14-2	NE1/4, SE1/4, sec. 9, T. 35 N., R. 19 E.
14-3	NW1/4, SE1/4, sec. 10, T. 35 N., R. 19 E.
14-4	NE1/4, NW1/4, sec. 14, T. 35 N., R. 19 E.
14-5	NE1/4, NW1/4, sec. 6, T. 35 N., R. 20 E.
15-1	NW1/4, NW1/4, sec. 33, T. 34 N., R. 18 E.
15-3	NE1/4, SW1/4, sec. 1, T. 33 N., R. 18 E.
15-4	SW1/4, NE1/4, sec. 7, T. 33 N., R. 19 E.
15-5	SW1/4, SW1/4, sec. 17, T. 33 N., R. 19 E.
16-1	SE1/4, SE1/4, sec. 18, T. 33 N., R. 19 E.
16-2	SW1/4, SW1/4, sec. 18, T. 33 N., R. 19 E.
16-3	NW1/4, NE1/4, sec. 10, T. 33 N., R. 18 E.
16-4	NE1/4, NW1/4, sec. 14, T. 33 N., R. 18 E.
16-5	SE1/4, NE1/4, sec. 1, T. 32 N., R. 18 E.
16-6	SW1/4, SW1/4, sec. 32, T. 33 N., R. 19 E.

Appendix 2. Petrographic descriptions. [*] See Appendix 3 for modal analysis.

Merrill Area

1-1 dark gray, medium-grained quartz diorite composed of anhedral quartz (20-30%), dusty, subhedral plagioclase An_{35-40} (50-60%), green hornblende (20-30%), and a trace of fresh interstitial microcline. Apatite and epidote are the major accessory minerals.

*1-2 dark gray, medium-grained quartz diorite gneiss similar to sample 1-1, but foliated.

Antigo Area

1-3 pink, medium- to coarse-grained quartz diorite composed of polycrystalline quartz (35-40%), saussuritized zoned, subhedral plagioclase An_{30-35} (40-45%), fresh interstitial microcline (5-15%), dark brown biotite and a little green hornblende. Accessories include apatite and a little zircon.

*1-4 pink, medium- to coarse-grained quartz diorite similar to sample 1-3.

2-1 gray, fine- to medium-grained diorite gneiss composed of zoned, subhedral plagioclase An_{30-35} (60-70%), brown biotite (15-20%) and green hornblende (5%). Anhedral sphene was the only accessory.

2-2 dark gray, medium- to coarse-grained diorite similar to sample 2-1.

2-3 gray, metamorphosed medium-grained granite composed of quartz (40-45%), plagioclase (25-30%), fine-grained muscovite (20-25%) and brown biotite (5-10%).

2-3A pink, fine-grained quartz monzonite composed of polycrystalline quartz (30-35%), altered subhedral plagioclase (30-35%), and anhedral perthitic microcline (30-35%).

*2-4 pink, medium-grained quartz monzonite similar to sample 2-3A but more stained. Accessories include allanite.

Grandfather Dam Area

3-1 biege, fine-grained diorite gneiss composed of anhedral quartz (40-45%), anhedral anorthoclase and sanidine (40-45%), fresh anhedral plagioclase (5-10%), brown biotite (5%) and a little muscovite. Accessories include sphene and apatite.

4-2 fine- to medium-grained gray, granite gneiss composed of anhedral quartz (40-45%), dusty subhedral plagioclase. An_{25-30} (30-35%), fresh anhedral microcline (5-10%), brown biotite (5-10%) and green hornblende (5%). Epidote is the main accessory mineral.

Tomahawk Area

*4-3 orange, medium-grained granite composed of strained, anhedral quartz, zoned subhedral plagioclase An_{10-15} with abundant hematite inclusions, microcline, brown biotite and a little green hornblende. Accessories include epidote, sphene, and apatite.

4-4 orange medium- to coarse granite gneiss similar to sample 4-3 but more strained.

5-1 grayish-pink, fine-grained quartz monzonite composed of polycrystalline quartz (20-25%), zoned subhedral plagioclase An_{10-15} (25-30%), anhedral microcline (25-30%), brown biotite and a little orthoclase. Accessories include epidote and zircon.

Rhinelander Area

5-2A gray, metamorphosed mafic porphyry composed of light gray megacrysts of plagioclase An_{40-45} (45-50%), and microcline (5-10%) in a groundmass of plagioclase, brown biotite and green hornblende (50%).

5-2B white, metamorphosed medium-grained granite composed of ragged polycrystalline quartz (40-45%), dusty zoned plagioclase An_{20-25} (40-45%), epidote and chlorite (10%).

*5-3 pink, medium-grained granodiorite composed of polycrystalline quartz, lenticular plagioclase An_{5-10}, epidote and a little microcline. Accessories include chlorite and sphene.

*5-4 beige medium- to coarse-grained granodiorite composed of anhedral quartz, anhedral antiperthitic plagioclase An_{25-30} (faintly zoned) fresh anhedral microcline, brown biotite and muscovite. Many indications of strain are apparent.

Northern Area

6-1 beige fine- to medium-grained granite composed of quartz (30-35%) dusty, zoned, anhedral plagioclase (15-20%), slightly perthitic microcline (35-50%), and brown biotite (5%). Accessories include a little zircon and apatite.

6-2 pink, granite pegmatite composed of microcline, quartz and almandine garnet.

*6-3 (Alvin) pink, porphyritic medium-grained granite composed of anhedral quartz, saussuritized euhedral plagioclase, megacrysts of perthitic microcline, and green euhedral hornblende. Accessories include epidote, a little zircon and sphene.

*6-4 (Argonne) pink, medium-grained quartz monzonite gneiss composed of polycrystalline quartz, altered, rounded plagioclase, fresh anhedral slightly perthitic microcline, subequal green hornblende and brown biotite, and pink, euhedral helicitic garnet. Accessories include abundant epidote, a little zircon and apatite.

7-2 (Laona Junction) gray, metamorphosed, medium-grained diorite composed of quartz (10%), zoned subhedral plagioclase An_{30-35} (45-50%), green euhedral hornblende and brown biotite (45-50%). Sphene is the main accessory. The mineralogy varies within a single thin section from the above to a mosaic of fresh anhedral plagioclase, epidote and chlorite (which replace hornblende and biotite).

Three Lakes Area

7-3 pale gray, medium-grained quartz diorite gneiss composed of anhedral quartz (25-30%), zoned, subhedral plagioclase An_{30-35} (50-55%), brown biotite and green hornblende (15%). Epidote is the main accessory, although chalcopyrite was also observed.

*7-4 pale gray, medium-grained quartz diorite gneiss composed of anhedral quartz, zoned plagioclase An_{25-30}, some perthitic orthoclase, and a little apatite.

7-5 greenish black amphibolite composed of green anhedral hornblende (50%) and plagioclase An_{40-45} (50%).

*8-1 *(Northern) beige medium-grained granite composed of anhedral quartz,* plagioclase, slightly perthitic microcline, brown biotite and muscovite.

8-2 (Carter) grayish green to pink, fine-grained granite composed of microcline (35-40%) poikilitically enclosing quartz (35-40%). Brown biotite (5-10%), and plagioclase (trace) were also present. Probably a granitized sandstone.

8-3 (miscellaneous) pink, medium-grained quartz monzonite composed of quartz, zoned, subhedral plagioclase, anhedral microcline, brown biotite and green hornblende.

Morgan Lake Area

8-4 beige medium- to coarse-grained granite composed of quartz (30-35%), altered subhedral to euhedral plagioclase (15-20%), perthitic microcline (40-45%) and brown biotite (5%). Accessories include muscovite and abundant zircon.

8-5 beige medium- to coarse-grained quartz monzonite composed of anhedral quartz (20-25%), zoned subhedral plagioclase An_{15-20} (20-25%), slightly perthitic microcline (30-35%), and brown biotite (5-10%). Accessories include zircon.

*9-1 beige medium- to coarse-grained granite composed of quartz, altered plagioclase, perthitic microcline, and brown biotite. Zircon is the main accessory.

9-2 (miscellaneous) pink, medium-grained granite composed of coarse polycrystalline quartz (35-40%), very altered subhedral to euhedral plagioclase (20-25%), slightly perthitic microcline (30-35%), and a little orthoclase, brown biotite and blue green hornblende (5-10%). Accessories include zircon and sphene. Microcrystalline quartz fills cracks in the above minerals.

Strong Falls Area

9-3 pink, coarse-grained granite composed of anhedral quartz (20-25%), faintly zoned, subhedral to euhedral plagioclase (20-25%), very perthitic microcline (30-35%), biotite and chlorite (5-10%). Accessories include abundant zircon.

*9-4 pink, coarse-grained granite composed of quartz, subhedral to euhedral plagioclase, very perthitic microcline, brown biotite and green hornblende. Zircon is the major accessory.

9-5 pink, medium- to coarse-grained granite composed of quartz (25-30%), subhedral plagioclase An_{10-15} (15-20%), very perthitic microcline, (30-35%), brown biotite and green hornblende (45%). Accessories include zircon.

Athelstane Quartz Monzonite

10-1 pink, medium-grained quartz monzonite composed of anhedral quartz (20-25%), euhedral to subhedral plagioclase slightly antiperthitic (30-35%), perthitic (patchy) microcline (30-35%), brown biotite and green hornblende (5-10%). Accessories include abundant zircon, a little apatite and sphene.

10-2 pink, coarse-grained granite composed of polycrystalline quartz (35-40%), euhedral plagioclase An_{10-15} (30-35%), slightly perthitic microcline (35-40%), brown biotite and green hornblende (5%).

10-3 pink, medium-grained granite similar to 10-2 though slightly more stained.

10-5 pink, medium-grained granite similar to 10-2.

*10-7 pinkish orange porphyritic granite composed of quartz sericitized plagioclase, perthitic (patchy to braided) microcline, brown biotite and green hornblende surrounding megacrysts of microcline. Accessories include zircon, apatite, opaques and epidote.

10-8 pinkish orange porphyritic granite similar to 10-7. 11-1pink, coarse-grained granodiorite composed of quartz (20-25%), anhedral to subhedral plagioclase (35%), nonperthitic to slightly perthitic microcline (20-25%), brown biotite and green hornblende (15-20%). Accessories include euhedral zircon, sphene, and epidote.

11-2 pink, coarse-grained quartz monzonite similar to 11-1.

11-3 pink, coarse-grained granite composed of cracked, strained quartz (20-25%), faintly twinned, altered plagioclase (20-25%), perthitic (braided) microcline (35-40%), brown biotite and green hornblende (10%). Accessories include zircon, sphene, and apatite.

11-4 pink, coarse-grained granite similar to 11-3 but less strained.

11-5 pink, medium- to coarse-grained quartz monzonite similar to 11-4 but slightly more mafic.

12-1 pink, coarse-grained quartz monzonite similar to 11-5.

12-2 pink, coarse-grained quartz monzonite similar to 11-5. Plagioclase An_{20-25}.

12-3 pink, coarse to medium-grained quartz monzonite similar to 11-5.

12-4 pink, coarse to medium-grained quartz monzonite similar to 11-5.

*12-5 pink, coarse to medium-grained quartz monzonite similar to 11-5. Plagioclase An_{25-30}.

12-6 pink, coarse to medium-grained quartz monzonite similar to 11-5. Plagioclase An_{20-25}.

13-1 pink, coarse to medium-grained granodiorite similar to 11-5. Plagioclase An_{30-35}.

13-2 pink, coarse to medium-grained quartz monzonite similar to 11-5.

13-3 pink, coarse to medium-grained quartz monzonite similar to 11-5. Plagioclase An_{20-25}.

13-4 gray, fine-grained biotite schist composed of lenticular, strained quartz (40%), poorly twinned subhedral to anhedral plagioclase (25%), nonperthitic microcline (15%), red-brown biotite, pale green hornblende and epidote (25%). Accessories include hematite, apatite, and a little zircon.

13-5 gray, fine-grained biotite schist similar to 13-4.

14-1 pink, medium-grained quartz monzonite similar to 11-5.

*14-2 gray, medium-grained quartz diorite composed of anhedral quartz, anhedral plagioclase An_{35-40}, a little interstitial microcline, and clots of green hornblende and red-brown biotite. Accessories include apatite, zircon, sphene and allanite.

14-3 dark pink, medium-grained quartz diorite gneiss composed of polycrystalline quartz (15-20%), zoned subhedral plagioclase An_{25-30}, a little microcline and red-brown biotite (10-15%). Accessories include sphene, epidote, and a little zircon.

*14-4 white, fine-grained quartz monzonite composed of polycrystalline, zoned subhedral plagioclase An_{20-30}, slightly perthitic microcline, and red-brown biotite. Zircon, epidote, chlorite and sphene are the accessories.

14-5 white, fine-grained granite similar to 14-4 except more acidic.

15-1 pink, fine- to medium-grained granite composed of quartz (20-25%), subhedral plagioclase (20-25%), non-perthitic microcline (30-35%), brown biotite and green hornblende (10-15%). Accessories include epidote, zircon and apatite.

*15-3 white, fine- to medium-grained quartz diorite composed of polycrystalline quartz, plagioclase with inclusions of microcline, and brown biotite. Accessories include opaques and stubbly euhedral zircon.

15-4 pink, coarse-grained granite similar to 11-5.

16-1 pink, coarse-grained porphyritic quartz monzonite similar to 11-5 with megacrysts of microcline.

16-2 pink, coarse-grained porphyritic quartz monzonite similar to 11-5.

16-3 dark green medium-grained diorite composed of cloudy plagioclase poikilitically enclosed in pale green hornblende with some interstitial quartz. Accessories include epidote, apatite, and opaques.

16-4 pink, medium- to coarse-grained quartz monzonite composed of quartz (25-30%), plagioclase (30-35%), non-perthitic microcline (20-25%), green hornblende and brown biotite. Accessories include zircon and apatite.

16-5 dark pink, medium- to coarse-grained porphyritic granodiorite composed of quartz (30-35%), plagioclase (35-40%), very perthitic microcline (25-30%), brownish green poikilitic hornblende and a little brown biotite in a groundmass of similar mineralogy and microlite inclusions. Accessories are apatite and sphene.

*16-6 pink, medium- to fine-grained quartz monzonite composed of quartz, very altered plagioclase, slightly perthitic microcline, brown biotite and green hornblende. Accessories are epidote, chlorite, and zircon.

Appendix 3. Modal mineralogy [ep = epidote, z = zircon, ap = apatite, al = allanite, sp = sphene, cl = chlorite, tr = trace]

	1-2	1-4	2-4	4-3	5-3
Quartz	20.9	25.4	29.4	25.1	45.0
Plagioclase	50.2	51.3	41.6	24.8	41.4
Microcline	0.5	15.9	18.6	37.3	tr
Hornblende	28.4	tr	-	tr	-
Biotite	7.4	8.8	10.7	-	
Other	-	-		2.2 ep	13.6 ep
Accessory	-	z,ap	al	sp,ap	cl,sp.

	5-4	6-3	6-4	7-4	8-1
Quartz	26.0	26.5	36.7	33.3	25.0
Plagioclase	50.4	25.7	27.0	60.3	27.8
Microcline	17.4	34.7	30.6	1.7	36.3
Hornblende	-	13.3	2.2	tr	-
Biotite	7.3	tr	3.2	4.7	10.9
Other	-	-	-	-	
Accessory	-	z,sp	ep,z,ap	ap	-

	8-3	9-1	9-4	10-7	12-5
Quartz	32.6	27.7	31.9	31.5	30.4
Plagioclase	27.5	15.0	19.4	18.5	31.1
Microcline	26.3	44.0	39.6	47.4	30.5
Hornblende	3.5	-	4.5	1.3	0.9
Biotite	10.1	8.5	4.6	1.3	7.1
Other	-	-	-	-	-
Accessory	-	z	z	z,ap,ep	-

	14-2	14-4	14-5	15-3	16-6
Quartz	7.9	31.4	33.8	41.3	26.5
Plagioclase	41.6	29.2	26.0	51.7	33.7
Microcline	3.6	30.4	36.2	2.0	30.8
Hornblende	32.5	tr	tr	-	4.5
Biotite	14.1	8.8	3.9	5.0	4.5
Other	-	-	-	-	
Accessory	ap,z,sp al	z,ep,cl	z	z	ep,cl,z

Appendix 4. Chemical analyses *Note: Oxides are in weight per cent. In calculation of norms iron assumed to be 2/3 unoxidized. Q=quartz; Or=orthoclase; Ab=albite; An=anorthite; C=corundum; W=wollastonite; M=total mafics; DI=differentiation index.

Chemical analyses

	1-1	1-2	1-3	1-4	2-1	2-2
SiO_2	64.76	64.60	67.15	67.69	60.73	60.45
Al_2O_3	14.61	14.66	14.61	15.08	18.21	14.66
FeO	4.61	4.78	3.28	3.37	5.55	7.76
MgO	1.59	1.63	0.76	0.67	1.09	2.43
CaO	5.72	5.38	3.09	2.94	4.26	6.01
Na_2O	2.86	2.98	2.88	3.01	3.59	2.81
K_2O	0.01	0.00	3.06	2.40	2.35	1.09
SUM	94.16	94.07	94.83	95.16	95.78	95.21
Molecular nomms						
Q	31.0	32.2	29.2	32.5	15.5	18.7
Or	0	0	19.4	15.1	15.1	7.1
Ab	28.2	29.0	28.0	28.8	34.8	27.8
An	12.1	28.8	16.2	15.6	22.9	30.4
C	0	0	1.1	2.5	2.4	0
M	3.8	10	5.7	5.5	9.3	18.7
DI	58.2	61.2	77.6	74.4	65.4	53.6

Chemical analyses

	2-3	2-3A	2-4	3-1	4-2	5-1
SiO_2	70.50	72.62	74.15	75.34	70.82	71.28
Al_2O_3	14.27	12.91	13.24	12.91	14.78	15.58
FeO	2.93	1.24	2.25	2.50	3.65	2.84
MgO	0.54	0.14	0.23	0.28	0.64	0.48
CaO	2.51	1.41	1.96	0.92	3.30	2.44
Na_2O	2.76	2.90	3.13	2.50	3.06	2.70
K_2O	2.47	4.00	3.15	4.77	2.73	3.63
SUM	95.98	95.22	98.11	99.22	98.98	98.95
Molecular norms						
Q	37.4	36.2	37.5	38.0	31.9	33.2
Or	15.5	25.1	19.2	29.2	16.7	22.0
Ab	26.3	27.5	29.0	23.2	28.2	24.8
An	13.3	7.2	10.0	4.7	16.8	12.4
C	2.8	1.5	1.4	2.1	0.8	3.0
M	4.7	2.4	2.9	2.8	5.7	4.4
DI	79.2	88.8	84.7	90.4	76.8	80.0

Chemical analyses

	5-2A	5-2B	9-4	5-4	6-1	6-2
SiO_2	73.14	50.89	76.19	71.94	72.32	74.37
Al_2O_3	14.88	20.20	12.96	16.50	15.18	14.92
FeO	2.96	7.84	2.22	1.67	2.06	2.97
MgO	0.80	3.19	0.21	0.26	0.39	0.30
CaO	3.05	5.97	0.66	3.46	1.99	1.26
Na_2O	4.04	3.34	2.68	3.30	3.06	3.97
K_2O	1.49	5.09	5.11	1.61	1.70	4.03
SUM	100.36	96.52	100.03	98.74	96.70	101.82

Molecular norms

Q	33.1	0	36.5	36.5	41.5	32.6
Or	8.9	30.8	30.8	9.8	10.6	22.8
Ab	36.4	30.7	24.4	30.4	28.9	35.7
An	15.2	27.2	3.4	17.6	10.4	0.6
C	1.2	0	2.0	3.3	5.4	4.4
M	5.2	11.7	2.9	2.5	3.8	3.84
DI	78.4	88.7	91.7	76.7	81.0	91.1

Chemical analyses

	6-3	6-4	7-2	7-3	7-4	7-5
SiO_2	71.57	74.68	55.93	61.01	76.09	47.47
Al_2O_3	14.46	13.42	17.13	18.07	15.20	17.69
FeO	3.63	3.95	7.61	6.31	2.12	11.47
MgO	0.56	0.26	2.23	1.25	0.40	4.04
CaO	1.96	2.38	7.80	5.89	3.66	11.84
Na_2O	2.45	3.32	2.44	2.82	3.49	1.39
K_2O	5.53	1.91	0.95	1.93	0.52	0.23
SUM	100.16	99.92	94.09	97.28	101.48	94.13

Molecular norms

Q	30.5	39.3	12.7	4.1	41.6	8.0
Or	33.5	11.6	6.3	11.9	3.1	1.5
Ab	19.0	30.4	24.4	26.4	31.4	14.0
An	10.0	12.1	39.6	30.5	18.3	46.2
C	1.7	1.8	0.7w	0.8	2.4	4.0w
M	5.4	4.8	16.3	26.4	3.3	26.3
DI	83.0	81.3	43.4	42.4	86.1	23.5

Chemical analyses

	8-1	8-2	8-3	8-5	9-1	9-3
SiO_2	75.93	73.56	76.13	75.87	73.09	71.23
Al_2O_3	14.49	13.90	13.94	14.43	14.55	13.02
FeO	1.48	2.39	3.88	1.84	1.76	2.90
MgO	0.31	1.22	0.25	0.33	0.29	0.32
CaO	2.12	2.50	2.12	1.14	0.88	0.57
Na_2O	2.82	1.96	3.26	2.68	2.47	2.53
K_2O	3.74	5.14	2.41	5.23	6.12	5.23
SUM	100.89	100.67	101.99	101.52	99.16	95.80

Molecular norms

Q	37.2	32.5	39.0	30.8	30.7	33.4
Or	22.3	30.8	14.2	37.0	37.1	32.9
Ab	25.4	17.8	29.3	22.6	22.7	24.1
An	10.6	12.6	10.6	4.4	4.4	3.0
C	2.1	0.6	2.3	2.5	2.5	2.5
M	2.4	5.9	4.6	2.7	2.7	4.1
DI	84.9	81.1	82.5	90.4	90.5	90.4

Chemical analyses

	5-3	9-5	10-1	10-2	10-5	10-7
SiO_2	75.26	73.85	69.88	74.50	72.67	77.86
Al_2O_3	11.30	11.47	15.01	13.17	13.84	12.20
FeO	2.16	3.10	4.30	2.16	2.33	1.33
MgO	0.32	0.14	0.41	0.27	0.38	0.09
CaO	2.37	1.39	1.83	1.74	1.96	0.77
Na_2O	3.43	2.46	2.74	2.95	2.87	2.20
K_2O	1.01	4.24	5.73	4.58	4.22	5.45
SUM	95.85	96.65	99.90	99.37	98.27	99.90

Molecular norms

Q45.8	38.6	25.1	33.4	33.1	40.4	
Or	6.2	26.5	34.5	27.5	25.8	32.5
Ab	31.5	23.5	24.5	22.0	26.5	20.0
An	12.5	7.1	9.0	8.6	9.8	3.5
C	0.6	0.4	1.1	0.4	1.2	1.6
M	3.4	3.9	5.2	3.1	3.5	2.0
DI	83.5	88.6	86.1	80.9	85.4	92.9

Chemical analyses

	12-5	11-4	12-6	13-2	13-5	14-2
SiO_2	68.49	71.30	73.16	70.00	68.38	56.95
Al_2O_3	13.98	12.70	13.45	14.10	13.91	15.40
FeO	3.74	3.18	3.72	3.86	4.80	7.59
MgO	0.51	0.41	0.42	0.50	0.55	2.73
CaO	3.00	1.52	2.49	2.27	2.32	7.74
Na_2O	3.19	3.14	2.91	2.33	2.51	2.45
K_2O	3.22	5.14	3.10	5.47	1.92	1.26
SUM	96.13	97.39	99.25	98.53	94.39	94.12

Molecular norms

Q	29.0	27.8	36.0	27.4	39.8	15.3
Or	20.0	31.6	18.8	33.4	12.1	8
Ab	30.0	29	26.5	22.0	24.6	23.5
An	15.6	7.5	12.6	11.4	12.4	31.9
C	0	0.1	1.0	0.2	4.2	4.8w
M	5.5	4.6	5.2	5.4	6.9	16.5
DI	79	88.4	81.3	82.8	76.5	46.8

Chemical analyses

	14-5	15-4	16-3	16-5	16-6	4-4
SiO_2	69.68	72.25	50.23	64.17	73.47	70.42
Al_2O_3	13.67	13.54	19.86	17.15	14.58	14.15
FeO	2.82	2.10	5.58	5.89	3.34	3.42
MgO	0.32	0.37	4.47	0.28	0.52	0.51
CaO	2.34	1.68	11.62	2.48	2.25	1.25
Na_2O	3.00	2.22	1.49	3.64	2.71	3.46
K_2O	4.25	5.06	0.92	5.54	3.84	3.23
SUM	96.09	97.22	94.17	99.15	100.71	96.44

Molecular norms

Q	29.1	34.3	6.8	13.6	28.9	32.7
Or	26.5	31.2	5.9	33.3	23.4	20.0
Ab	28.5	21.0	14.5	24.5	30.9	32.6
An	12.1	8.6	62.3	12.5	11.0	6.5
C	0	1.6	3.7w	1.2	0.4	3.1
M	3.8	3.2	6.76	5.7	5.5	5.2
DI	84.1	86.5	27.2	71.4	85.2	85.3