PETROGRAPHIC AND MODAL ANALYSIS OF THE ANDESITE OF MARBLE CREEK, SOUTHEASTERN MISSOURI

IRA R. SATTERFIELD
Southern Illinois University, Carbondale

ABSTRACT. — A detailed field and petrographic investigation was made of the andesite of Marble Creek in the St. Francois Mountains of southeastern Missouri. The area is characterized by hills of Precambrian granitic and felsitic rocks which rise topographically above unconformably overlying Cambrian strata. The andesite has a porphyritic texture, contains an abnormally high percentage of plagioclase, and quartz, and only minor amounts of biotite, hornblende, and augite. Petrographic and field studies lead the author to believe that the andesite was a flow.

GEOLOGY AND STRATIGRAPHY

The St. Francois Mountains, made up in part by the andesite of Marble Creek, form part of the Ozark Dome. The Dome is a broad, nearly circular, area of Cambrian and Ordovician limestones and dolomites surrounded by excarpments of Mississippian limestones. In the east central part of the St. Francois Mountains, knobs of Precambrian igenous rocks are exposed through the Cambrian and Ordovician strata. According to Hayes (1961) the erosional surface on the Precambrian rocks had considerable relief before the Cambrian seas transgressed the area. The Cambrian strata dip off the Precambrian at approximately 5 to 15 degrees but this in no way indicates the relief of the erosional surface before Cambrian times inasmuch as the area was uplifted contemporaneously with deposition.

In areas adjacent to the study area, the Precambrian rocks consist of a series of rhyolites and felsitic rocks intruded by granitic stocks and sills. Basic dikes and sills have intruded both felsitic rocks and granites. The largest mass of rhyolite, the Stouts Creek Rhyolite, occurs at the northern boundary of the study area. No contact between the rhyolite and the andesite was observed. The Stouts Creek Rhyolite and the andesite of Marble Creek are older than the intruding granites which, according to Allen (1959), range from 1200 m.y. to 1350 m.y. in age.

The andesite of Marble Creek is to be found between the towns of Arcadia and French Mills (FIG. 1). The andesite crops out along County Route E at two localities which jointly cover an area of approximately one-half square mile. The western area is located in the SW¼ Sec. 24, T.32N., R.4E. in Iron County and the eastern body is in the NW¼ Sec. 19, T32N., R.5E. in Madison County. Both areas are entirely within the Des Arc 15-minute Quadrangle, thus lying between me-

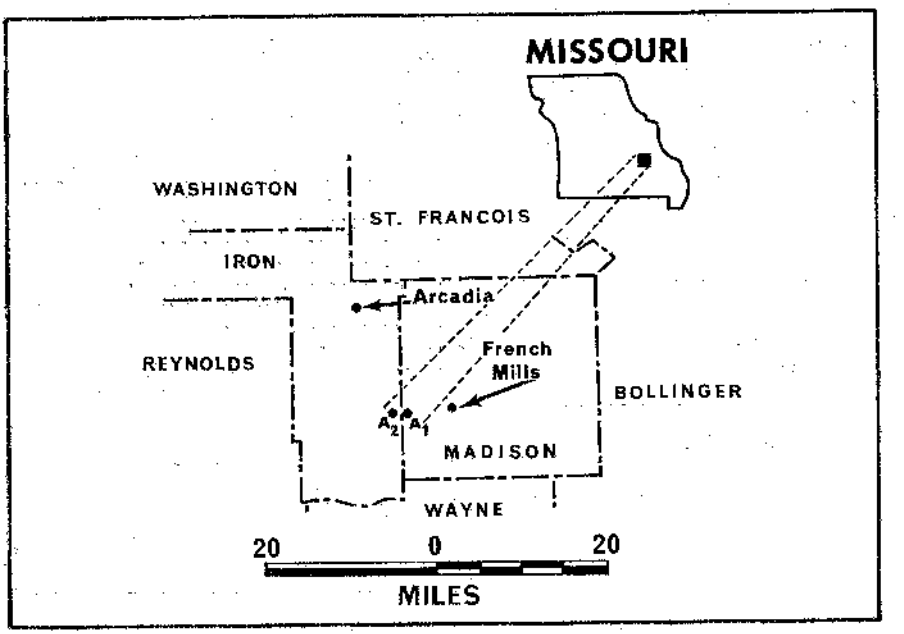

FIGURE 1. — Map showing location of andesite of Marble Creek in southeastern Missouri.

ridians 90°30′ and 90°45′ west longitude and parallels 37°15′ and 37°30′ north latitude.

Only one sedimentary formation, the Bonneterre Dolomite (Upper Cambrian), is exposed in the study area. The oldest sedimentary unit of Paleozoic age in the region, the Lamotte Sandstone, probably was not deposited locally. The dolomite is characteristically buff in color, coarsely crystalline, and produces a brownish-red soil. Strata of the Bonneterre surround all of the west andesite body A_2 and approximately two-thirds of the east body A_1 (FIG. 2). The exposed igneous rock weathers to a dark-colored, pitted surface.

PETROGRAPHY

Megascopic Description.—The andesite of Marble Creek is black, slightly vesicular, and generally prophyritic. Its most striking characteristics are that most of the euhedral plagioclase phenocrysts have been slightly epidotized and that the andesite weathers to give a deep reddish-brown soil. Plagioclase phenocrysts range from 1mm to 6mm in length and constitute approximately 20 to 25 percent of the rock. There appears to be a slight linear orientation of the plagioclase phenocrysts but there is no apparent geometric orientation of the vesicles. The vesicles range from less than 1mm to 6mm in length.

Thin Section Analysis.—In body A_1 the rock is composed of plagioclase, quartz and hornblende, magnetite, and accessory minerals (TABLE 1). Andesine feldspar comprises approximately 70.5 percent of the slides and occurs as euhedral phenocrysts, which range from 2mm to 6mm in length and make up about one-third of the total plagioclase. Such phenocrysts tend to exhibit linear flow structure. Some of the phenocrysts show normal zoning and many are highly fractured, but such fractures do not extend into the groundmass. All of the plagioclase crystals in the mesostasis along the plagioclase phenocrysts tend to parallel the phenocrysts. Magnetite tends to be disseminated equally

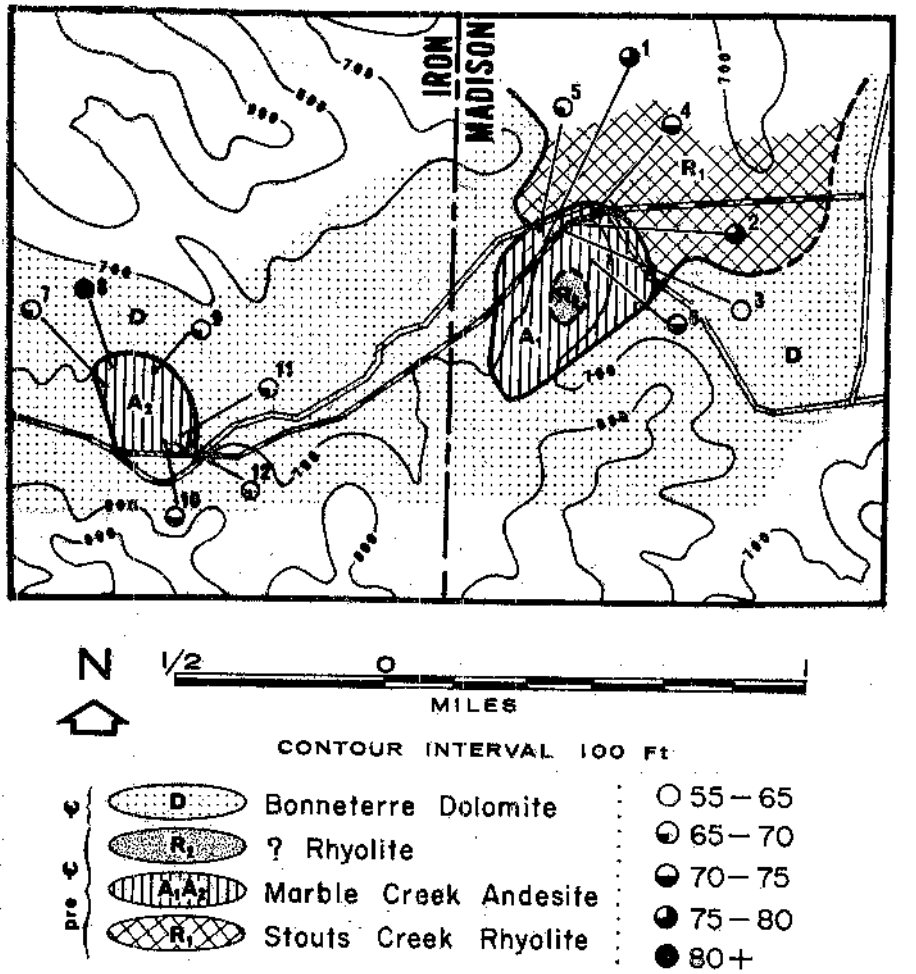

FIGURE 2.—Geologic map of the area showing locations of the samples and approximate percent of plagioclase feldspar. Sample numbers correspond with Modal Analysis in Table I.

throughout the rock. A few crystals are up to 3mm in length. Several of the slides have thin (1mm) quartz veins which contain a small amount of sericite. The quartz is confined to veins, to groundmass, and to vesicular filling. All of the augite, hornblende, and most of the plagioclase show deuteric alteration and replacement.

In body A_2 the rock is composed of plagioclase, quartz, calcite, magnetite, augite and hornblende, and accessory minerals (TABLE 1). Plagioclase feldspar comprises approximately 70.6 percent of the slides but their original composition is uncertain due to dueteric alteration. Such phenocrysts comprise about 8 to 10 percent of the total composition and differ in length from those in the eastern body—ranging 1mm to 3mm. The plagioclase phenocrysts have a parallel linear orientation suggestion flow and exhibit tensional fractures which do not extend into the groundmass. The plagioclase crystals in the mesostasis immediately adjacent to the plagioclase phenocrysts tend to parallel the border of the phenocrysts. Mag-

TABLE 1.—Modes of the Andesite of Marble Creek, Missouri (In Percent)

Body A_1

Location and Number	1	2	3	4	5	6
Plagioclase[1]	28.2	15.9	21.9	21.2	24.4	0.3
Quartz	.....	6.7	3.2	.....	.....	1.2
Magnetite	5.5	3.4	2.0	2.6	11.0	1.1
Calcite	.....	.....	.....	.....	.....	.....
Accessory[2]	4.1	1.5	35.4	11.5	3.6	1.3
Groundmass	62.2	72.5	37.5	64.7	61.0	96.1
(a) Plagioclase	76.3	82.3	94.4	79.1	72.8	76.4
(b) Quartz	14.2	15.4	.....	12.9	.....	8.0
(c) Magnetite	9.5	2.2	5.6	8.0	27.2	15.6
Total Plagioclase	75.6	75.5	57.0	72.4	68.8	73.7

Body A_2

Location and Number	7	8	9	10	11	12
Plagioclase[1]	6.3	2.9	5.3	6.5	4.5	0.5
Quartz	1.5	4.6	.....	4.7	0.2	.....
Magnetite	0.3	0.2	0.8	0.4	1.1	0.6
Calcite	2.8	.....	4.0	3.2	0.2	.....
Accessory[2]	9.3	0.4	4.9	2.3	2.5	.....
Groundmass	79.8	91.9	85.0	82.9	91.5	98.9
(a) Plagioclase	84.4	84.7	75.0	77.1	70.5	65.7
(b) Quartz	.....	12.0	9.4	8.9	14.0	10.8
(c) Magnetite	15.6	3.3	15.5	14.0	15.5	23.5
Total Plagioclase	69.1	80.7	69.0	70.4	69.0	65.4

[1] Andesine phenocrysts with extinction angles in mid-upper 20's.
[2] This group is composed of augite, hornblende, chlorite and epodite.

netite is disseminated equally throughout the slides with a few crystals up to ½mm in diameter. The rock is considerably more vesicular than those of the eastern body A_1 but the vesicles do not appear to have any geometric orientation. Most of the vesicles have been filled with calcite which in turn has been partially replaced by later calcite and chalcedonic quartz. All of the augite, hornblende, and plagioclase phenocrysts show dueteric alteration and replacement. Most of the slides contain small quartz vein (½mm). The quartz is restricted to the veins, mesostasis, and vesicles.

DISCUSSION

The plagioclase phenocrysts were the first to crystallize out of solution. This is exhibited by the euhedral crystal form, the tensional fractures in the plagioclase, and that the plagioclase crystals in the mesostasis tend to be parallel with the plagioclase phenocrysts. No biotite, and only a small amount of hornblende, was encountered in any of the thin sections examined.

The high percentage of plagioclase might be explained if the crystallizing magma rose to the surface slowly.

Much of the quartz was added later after the bodies solidified as evidenced by the quartz veins and quartz replacing calcite in the vesicles.

No contacts were observed in the field mapping; hence, the author did not observe any strongly affirmative criteria which would distinguish the bodies as a flow or a sill. A flow origin is favored because: (a) the underlying Stouts Creek Rhyolite is a flow (Hayes, 1961), (b) flow structure was observed in the field and in the thin sections, (c) the overlying rhyolite is probably a flow, (d) the tensional fractures in the plagioclase phenocrysts, and (e) the plagioclase crystals in the mesostasis tend to parallel in orientation the immediately adjacent plagioclase phenocrysts.

Due to the abnormally high percentage of plagioclase, the andesite should be called 'feldspathic andesite'.

Acknowledgments

The writer wishes to thank the Geology Department of Southern Illinois University for the use of the equipment and facilities. He also wishes to extend thanks to Dr. Dewey H. Amos for his assistance in the field and during the preparation of the manuscript.

Literature Cited

Allen, V. T. 1959. Age of Precambrian Igneous Rocks of Missouri. Geol. Soc. Am. Bull. 78; pp. 1560-1561.

Hayes, W. C. 1961. Guidebook to the Geology of the St. Francois Mountains. Missouri Geol. Surv. Rept. Inv. p. 137.

Manuscript received December 29, 1965.