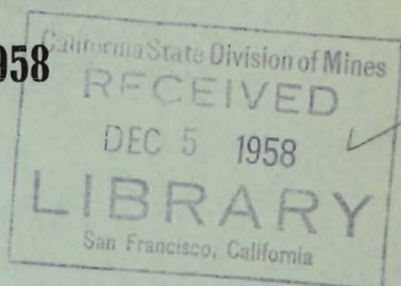


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DIVISION OF GEOLOGY

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DEPARTMENT OF GEOLOGY

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THE HARBISON META-GRANODIORITE

By
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Introduction

The igneous rocks of the Piedmont of South Carolina are intimately involved in the geologic processes that have produced the Appalachian orogenic belt. An understanding of these rocks is therefore essential to a satisfactory understanding of the regional geology; the rocks themselves and the plutons which they compose must be studied and mapped in detail. The present paper is a step in this direction. A small pluton of metamorphosed granodiorite near Columbia, South Carolina, is tentatively established as a working unit and named the Harbison meta-granodiorite after Harbison State Forest, within the bounds of which it is located. This may be the only occurrence of this unit that will be found, or it may serve as a type locality for many other occurrences of this same rock type. A metamorphosed igneous rock is not ideal as a defining type. There must be a starting point, however. If an unmetamorphosed equivalent of the Harbison meta-granodiorite is found later on, then the unit should be redefined.

Location

The Harbison meta-granodiorite composes a small pluton that is situated largely in the northeastern portion of the Irmo quadrangle, South Carolina; this body extends a short distance into the Columbia quadrangle on the east. It underlies about one square mile. The surrounding rocks are felsic varieties of the Carolina slate. The location of the area is shown

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BROAD RIVER

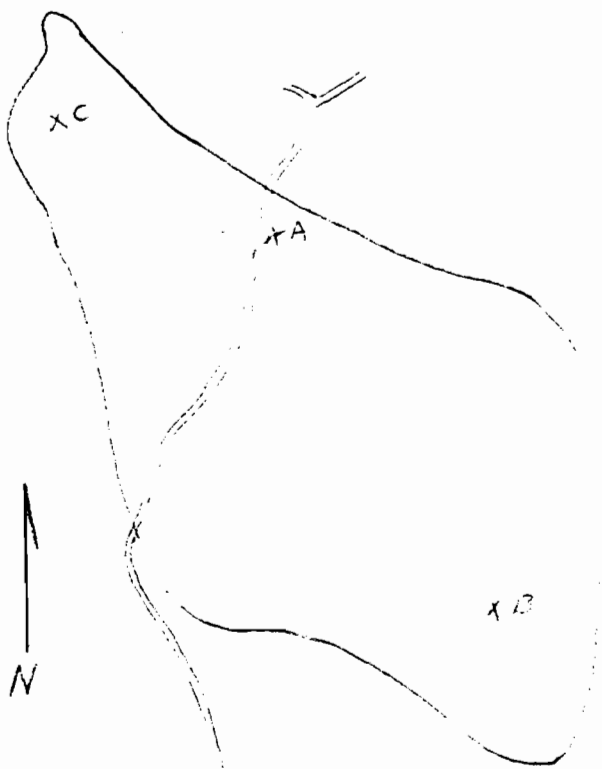
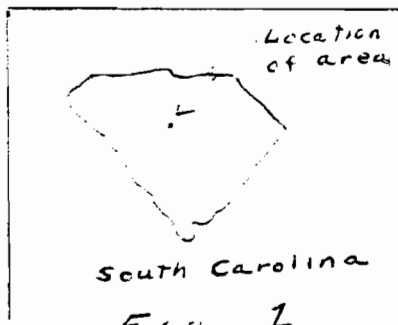
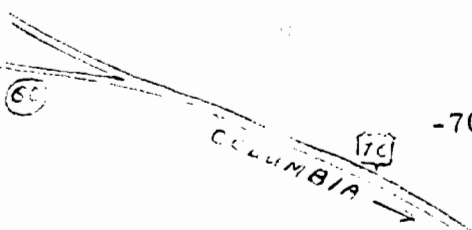


Fig. 2



South Carolina
Fig. 1



in Fig. 1, and a map of the pluton is illustrated in Fig. 2. The position of this pluton with respect to the regional geology is shown on the geologic map of the Irmo quadrangle by Heron and Johnson (1958).

Appearance in Outcrop

The Harbison meta-granodiorite is in general deeply weathered. An excellent exposure of decomposed but undisturbed material may be seen in a road cut at Locality A, Fig. 2. Although one can dig this material with a pick, the feldspar grains are still generally firm, and the biotite exhibits a luster.

Structure

Fresh specimens of the Harbison meta-granodiorite exhibit a barely perceptible foliation; it is produced by preferred orientation of the feldspar grains. This foliation is brought out strongly in the weathered material. The road cut at Locality A, Fig. 2, is the best undisturbed exposure that was found. Here the foliation is horizontal in general. There are minor deviations from the horizontal, however; these range up to a dip of 20° .

Several small masses are present in the road cut at locality A of Fig. 2 which appear to be xenoliths. These are rounded and are equant to elongate. The elongate masses are generally parallel to the foliation; the elongation of two of them, however, is vertical and thereby normal to the foliation. These xenoliths are deeply weathered and therefore could not be examined petrographically. Examination with the hand lens, however, indicated that they are appreciably richer in biotite than the surrounding rock.

There are two dikes at Locality A, Fig. 2, that cut vertically across the foliation of the meta-granodiorite. These bodies appear to be petrographically similar to the host; they differ perhaps in having a

smaller mafic content. The foliation within the dikes, however, is horizontal and passes without deviation into the foliation of the host rock. See the diagram in Fig. 3. The foliation in the exposure thus passes uniformly across host rock and dike with no feature unique to one or the other. The significance of this structural relationship is treated below in the section entitled "Discussion."

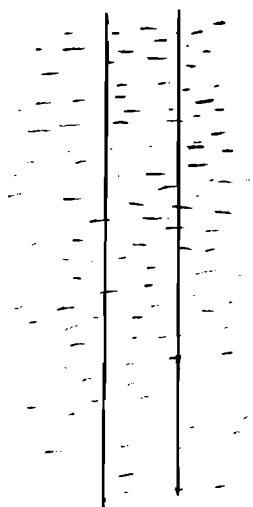


Fig. 3.

Petrography

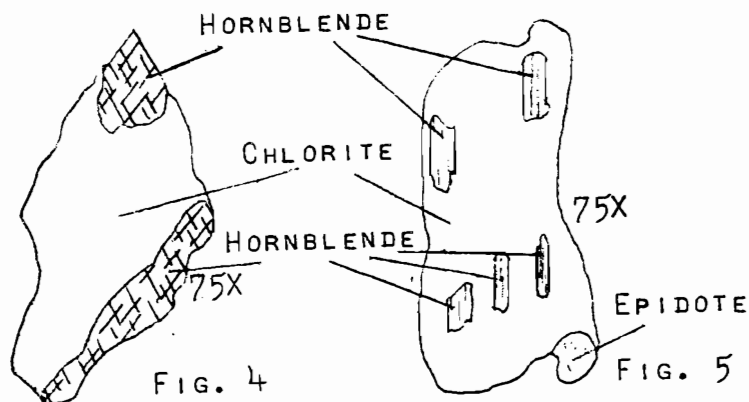
Relatively fresh specimens of Harbison meta-granodiorite have been found only as boulders. The rock is medium gray and is distinguished by the presence of small (1 mm.) phenocrysts of feldspar embedded in a fine-grained ground-mass.

The rock in thin section exhibits a vestigial, but clearly distinguishable, porphyritic habit; euhedral phenocrysts of plagioclase are embedded in an aggregate of anhedral grains of plagioclase, microcline, quartz, chlorite, and epidote. The phenocrysts range in grain size from 0.5 mm. to 2.0 mm.

The plagioclase phenocrysts are generally sharply euhedral and rectangular in cross-section. The selvage of some of the crystals is zoned; the rim is more sodic than the interior. These grains are typically host to two alteration products that take the form of very fine disseminated grains. These alteration products appear to be epidote and a mineral that has the properties of sericite. This latter mineral may be paragonite. The composition of the plagioclase is An_{30} .

Microcline is present as small anhedral grains in the groundmass and is distinguished only with difficulty. Identification was generally based on a Becke line comparison with quartz rather than on the presence of twinning, which is indeed hardly developed. The average grain size is 0.1 mm. A large amount of myrmekite occurs in this rock; this points to the former presence of a greater quantity of microcline.

Quartz occurs as small (0.1 mm.), isolated, anhedral grains throughout the groundmass and also in association with plagioclase as myrmekite. It does not occur aggregated in patches or lenses.



Hornblende is present as phenocrysts that have been largely altered to chlorite; fragments of the hornblende, isolated from one another by chlorite, occur in optical continuity. Two examples of such hornblende grains are illustrated in Figures 4 and 5. The hornblende is pleochroic: X = very light brown; Y = dull brown; Z = dull brown.

Chlorite occurs as anhedral grains (0.1 mm.) disseminated through the groundmass and also as a replacement of hornblende. It is pleochroic from

green to very pale yellow green.

Epidote occurs as equant, subhedral grains, and there are two orders of grain size. The smaller grains are about 0.01 mm. in diameter and occur disseminated in plagioclase. The larger grains are 0.1 to 0.3 mm. and occur more or less isolated.

A Rosiwal analysis of Harbison meta-granodiorite from Locality B, Fig. 2, is as follows:

Plagioclase	51%
Quartz	18%
Microcline	12%
Others (principally chlorite but also epidote and a little hornblende)	19%

There was much uncertainty about the content of potassium feldspar in this rock; therefore a chemical analysis was made for potassium. The specimen analyzed came from a fresh boulder at Locality C of Fig. 3, and Hahn Laboratories of Columbia, South Carolina, made the determination.

Potassium	1.84%
K_2O	2.22%

This corresponds to 12.79% normative orthoclase, which is remarkably consistent with the 12% microcline of the Rosiwal analysis.

The thin sections and hand specimens of the Harbison meta-granodiorite used in this study are on permanent file at the Mineral Industries Laboratory of the South Carolina Division of Geology.

Discussion

The porphyritic habit of the Harbison meta-granodiorite indicates an igneous origin, and the presence of xenoliths within it bears this out further. The preferred orientation of the phenocrysts parallel to the foliation in the rock suggests that the present horizontal structure

had its origin in the igneous or protoclastic stage. That the foliation passes undeflected across the metagranodiorite and the younger dikes (Fig. 3) suggests that there was a second stage in the development of the foliation, and that this second stage was parallel to the first. This latter stage may have been coincident with the metamorphic development that resulted in alteration of hornblende to chlorite and of plagioclase to epidote and sericite (paragonite?).

The following sequence of events is suggested for the area.

(1) Emplacement of hornblende granodiorite into a terrane of Carolina slate; attendant incorporation of xenoliths and development of a horizontal foliation.

(2) Emplacement of granitic dikes.

(3) Further development of foliation parallel to the primary foliation.

(3) Alteration of the mineral composition of the rock to a new mineral assemblage.

Stages (3) and (4) may have been contemporaneous.

References

Heron, S. D., Jr., and Johnson, H. S., Jr., 1958, Geology of the Irmo quadrangle, South Carolina: Div. of Geology, S. C. State Development Board

Notice to Readers

The Division of Geology, S. C. State Development Board, wishes to announce the availability of the following recent publications:

- (1) Bull. 2, Catalogue of the Mineral Localities of South Carolina, by Earle Sloan, 505 pages.. \$2.75(rpt)
- (2) Bull. 23, Silica for Glass Manufacture in South Carolina, by B. F. Buie and G. C. Robinson, 41 pages..... \$.50
- (3) Geology of the Irmo Quadrangle, S. C., map and text \$.25

SILICA FOR GLASS MANUFACTURE IN SOUTH CAROLINA

BY B. F. BUIE AND G. C. ROBINSON

ABSTRACT

Deposits of silica suitable for glass making in South Carolina include (1) sands of the Tuscaloosa formation of Cretaceous age, (2) sands of stream terrace and flood plain deposits and the margins of "Carolina Bays" in the Coastal Plain area, and (3) deposits of quartzite and vein quartz in the Piedmont area.

Although some of the quartz deposits of the Piedmont contain as little as 0.001 percent Fe_2O_3 and could be used for glass making, it is thought that the added cost of mining and preparing the hard rock quartz makes most of these deposits less attractive than the loose sand deposits of the Coastal Plain. Vein quartz that is extremely low in iron may, however, have some advantages for making special purpose glass.

Sands of stream terrace and flood plain deposits along the larger streams of the Coastal Plain and around the margins of "Carolina Bays" are commonly very low in iron content and can be used for glass making with little or no beneficiation. One glass plant has successfully used these sands for about 20 years.

Tremendous resources of high-silica sand occur in the Tuscaloosa formation of Cretaceous age and crop out in a broad belt trending northeastward across the central part of the State. By simple beneficiation these sands can be made into an excellent quality glass sand.

Laboratory work on samples taken during this study involved different combinations of washing, magnetic cleaning, and attrition grinding. Samples were evaluated by chemical analysis and by comparing test blocks of glass made from South Carolina sand with similar blocks made from a control sand from Ottawa, Illinois. After simple beneficiation, sands from eight South Carolina localities produced glass equal to or better than that made from the Ottawa control sand.

