COMMONWEALTH OF VIRGINIA
DEPARTMENT OF CONSERVATION
AND ECONOMIC DEVELOPMENT
DIVISION OF MINERAL RESOURCES

GEOLOGY OF THE MARTINSVILLE WEST QUADRANGLE, VIRGINIA

JAMES F. CONLEY AND
E. CLAYTON TOEWE

REPORT OF INVESTIGATIONS 16

VIRGINIA DIVISION OF MINERAL RESOURCES
James L. Calver
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Richmond
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CONTENTS

ILLUSTRATIONS

TABLE

GEOLOGY OF THE MARTINSVILLE WEST QUADRANGLE, VIRGINIA

By

James F. Conley

and

E. Clayton Toewe

ABSTRACT

The Martinsville West quadrangle is located in west-central Henry County in the southwestern Piedmont of Virginia. The quadrangle is underlain by rocks tentatively assigned a Cambrian or Precambrian age which are part of the inner Piedmont belt. They consist of sillimanite-mica schist, interbedded quartzite, biotite gneiss, and amphibolite. In the major downwarped structure in the area, these rocks were partially melted and converted into granite gneiss. This granite gneiss was in turn invaded by small dikes of ultramafic composition which have been altered to tremolite-talc schists. In possible late Paleozoic time the Leatherwood granite was emplaced, and it was subsequently intruded by Rich Acres Norite. The norite is cut by numerous feldspar-quartz pegmatites. During Late Triassic time diabase dikes were emplaced along zones of fracture. The major structure in the area is the nose and east limb of a northeastward-plunging syncline that is outlined by skialithic remnants of metamorphosed sedimentary rocks and foliations preserved in the paragneisses.

Crushed stone, sand and gravel, mica, and magnetite have been produced in the quadrangle, although the only mineral commodity in current production is crushed stone. Other mineral resources within the mapped area which might be of economic interest are: feldspar, kaolin, emery, soapstone, sillimanite, quartz, clay, gem stones, and vermiculite.

INTRODUCTION

The Martinsville West quadrangle is located in west-central Henry County in southern Virginia (Figure 1). It has an area of approximately 59.8 square miles, and is bounded by parallels 36°37′30″ and 36°45′00″ and meridians 79°52′30″ and 80°00′00″. The western part of the City of Martinsville, county seat of Henry County, is in the east-central part of the quadrangle. The communities of Collinsville and Fieldale are located in the northeastern and north-central parts of the area.

The quadrangle is situated about 20 miles east of the Blue Ridge escarpment and is in the inner Piedmont physiographic province as defined by Fenneman (1938, p. 139-140). The relief is typical of the inner Piedmont, and consists of rolling terrain underlain by granitic rocks, and elongate to arcuate steep-sided ridges upheld by resistant schists. Within the quadrangle, altitudes range from less than 660 feet at the surface of Smith River in the southeast corner of the quadrangle to approximately 1300 feet on a hill 0.8 mile due south of Horse Pasture. The average local relief above drainage is about 120 feet.

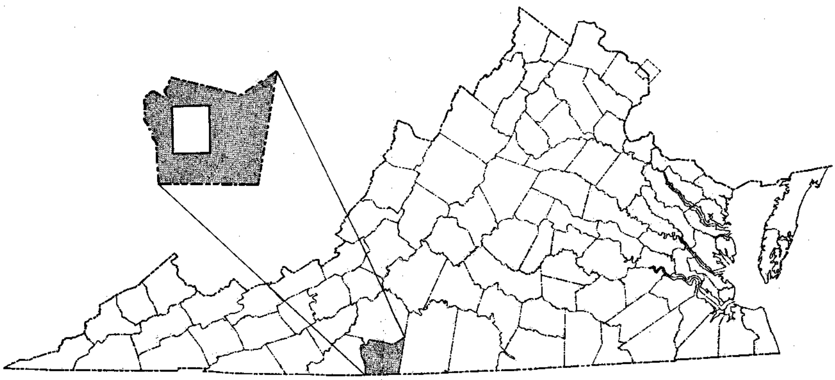


Figure 1. Index map showing location of Henry County and Martinsville West quadrangle.

The only other geologic investigation in the Martinsville area was made in conjunction with preparation of the Geologic Map of Virginia (Virginia Geological Survey, 1928). Three Precambrian units were recognized: the Wissahickon schist, the Leatherwood granite, and hornblende gabbro. In the map explanation it was noted that the Wissahickon schist, considered a metasedimentary unit in the Glenarm series, was intruded by the Leatherwood granite and the hornblende gabbro.

This quadrangle was chosen for detailed geologic mapping because of the presence of two large magnetic anomalies revealed by an aeromagnetic survey of the area (Virginia Division of Mineral Resources, 1966). During the investigation of these anomalies, high-rank metasedimentary rocks of the inner Piedmont belt, which had not been previously recognized in Virginia, were found. Particular emphasis was placed on foliation, lineations, and joints. Rock samples were collected, and 105 thin sections were prepared and examined. An additional 85 thin sections were stained for exact feldspar determination. Zircon samples were concentrated from four granite plutons, two norite plutons, two areas within the granite gneiss body, and two pegmatites, and correlations were made using reduced major axis statistical analyses.

The original investigation of the magnetic anomalies was suggested by Dr. James L. Calver, State Geologist. Kenneth M. Drummond provided the writers with information concerning the techniques that he had developed for collecting and extracting samples for zircon analyses. Thanks are extended to the quarry operators, industrial plant executives, and the private citizens who allowed access to their properties.

STRATIGRAPHY

Table 1 lists the geologic formations present in the Martinsville West quadrangle. Rocks assigned to the inner Piedmont belt (King, 1955, p. 352-356) were previously correlated with the Wissahickon schist of Pennsylvania (Virginia Geological Survey, 1928). These rocks have been regionally metamorphosed to the sillimanite-almandine-orthoclase subfacies of the almandine-amphibolite facies. The metasedimentary rocks have been partially changed in place into biotite gneiss, and have been intruded, from oldest to youngest, by metasomatic granite gneiss; ultramafic dikes and sills that were altered to tremolite-talc schists; and by Leatherwood granite, Rich Acres Norite, pegmatite dikes, and Triassic diabase dikes.

SILLIMANITE-MICA SCHIST

Sillimanite-mica schist occurs throughout the quadrangle, but the major part of the unit is in the central and eastern parts of the area where it underlies a number of cone-shaped hills and elongate ridges that follow regional foliation, and produce the highest topography in the area. With the exception of tremolite-talc schist, the sillimanite-mica schist is in contact with each rock unit mapped in the quadrangle. Throughout much of the area, it is in contact with biotite gneiss. This contact is generally diffused and gradational over several feet, but contacts with younger rocks in the area are distinct and are normally reflected topographically by a break in slope that becomes more gentle below the schist. It is typically exposed west of Hairston School, 0.25 mile south of the junction of State Roads 695 and 687 (R-3306) and on the hill east of State Road 684, 1 mile south of Fieldale (R-3284). (Numbers in parentheses correspond to sample localities on Plate 1; samples are on file in the rock and mineral repository of the Division of Mineral Resources at Charlottesville.) High relief and finely dissected topography are characteristic of the unit because the minerals composing the schist are extremely stable and resistant to chemical weathering.

In hand specimen the sillimanite-mica schist is a medium-gray to

Table 1.—Geologic formations in the Martinsville West quadrangle.

AGE	NAME	CHARACTER
Quaternary	Alluvium	Gray gravel, sand, silt, and clay
	Terrace deposits	White gravel and clay
	Colluvium	Red gravel, sand, silt, and clay
Triassic	Diabase	Black dikes composed of medium-grained diabase
Middle or Late Paleozoic (?)	Pegmatite	White dikes composed mainly of microcline, quartz, and muscovite
	Rich Acres Norite	Gray, coarse-grained norite
	Leatherwood granite	Light-gray, coarse-grained, porphyritic granite
Early Paleozoic (?)	Tremolite-talc schist	Green dikes composed of tremolite, talc, and vermiculite and cross-cut by pegmatites
	Granite gneiss	Light-gray, mineral-banded, medium-grained granite gneiss
	Amphibolite	Black, highly contorted, medium-grained, mineral-banded, amphibolite
Cambrian or Precambrian	Biotite gneiss	Medium-gray, mineral-banded, coarsely layered, medium- to coarse-grained biotite gneiss
	Quartzite	Light- to dark-gray, banded, fine-grained, equigranular, dense quartzite
	Sillimanite-mica schist	Light-gray, well-foliated, fine-grained mica schist containing porphyroblasts of garnet and bundles and disseminated grains of sillimanite throughout the matrix

greenish-gray, medium- to fine-grained rock that has a well-developed foliation caused by a combination of schistosity and mineral segregation banding. The mineral segregation bands consist of alternating light and dark layers. The lighter layers are composed of muscovite and sillimanite, whereas the darker layers are composed of muscovite, biotite, and chlorite. Sillimanite occurs as minute disseminated needle-like crystals oriented parallel to foliation and as fibrous bundles and wispy bands ranging from 1 mm to 8 mm in width and 2 cm to 10 cm in length. Garnet porphyroblasts ranging from 2 mm to 15 mm in diameter occur along some foliation planes.

On weathering, the banded appearance of the schist becomes more prominent due to the etching out of less-resistant mineral bands. Surfaces parallel to foliation develop an irregular "warty" appearance because weathered garnet porphyroblasts are left in relief. This is also true of individual crystals and fibrous bundles of sillimanite, which occur in relief on etched surfaces, making sillimanite the most easily recognized mineral in the weathered rock. The rock weathers to a deep-red and gray saprolite overlain by sandy-clay soils unsuitable for intensive agriculture. Where soils are shallow, the surface of the ground is littered with schist fragments and sillimanite bundles. Some of the saprolite has a spotted appearance because of weathering of garnets to ocherous masses.

In thin section, the rock is composed of, in order of abundance: mica, quartz, chlorite, opaque minerals, garnet, and sillimanite. In some thin sections biotite, orthoclase, hematite, goethite, kyanite, epidote, amphibole, clinozoisite, zoisite, anthophyllite, and zircon are also present. Mica, the major constituent in the rock, occurs both as muscovite and biotite porphyroblasts, up to 3 mm across, and as fine-grained sericite in the groundmass. Some of the large muscovite porphyroblasts enclose feldspars and seem to be alteration products of feldspar. In addition, some of the sericite has a fibrous appearance and partially to totally replaces sillimanite. Kyanite, where present, is also somewhat altered to sericite. Quartz occurs as irregular to sutured grains in the matrix and has been strained, but rarely shows Boehm lamellae. Some of the quartz has been replaced at the expense of mica and garnet crystals.

Deep-maroon almandine garnet occurs as augen with turbulent zones developed at either end (Figure 2). In some specimens the mineral is concentrated along the foliation of the enclosing schist, and in places (Plate 1, R-3296), as thin beds of almost pure garnet. The garnets are generally fractured and contain poikilitic inclusions of quartz and mica. In some samples (R-3327), garnets have alteration rims composed of chlorite, and alteration to either hematite or chlorite has proceeded along fracture boundaries within the porphyroblasts. Rosettes of clinochlore have been observed (R-3358) and probably represent garnets completely altered to chlorite. In addition, a pale-green to colorless muscovite occurs as subhedral to euhedral porphyroblasts containing numerous inclusions, and is oriented with its major axis at an angle to foliation. Most of the opaque grains are euhedral dipyramidal crystals of magnetite. Some are associated with chlorite and are products of alteration of iron garnet, and to a lesser extent, biotite.

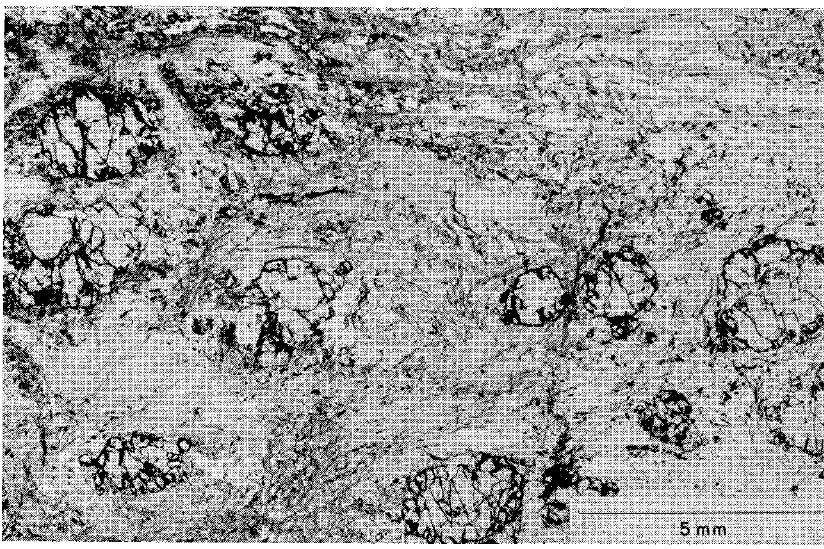
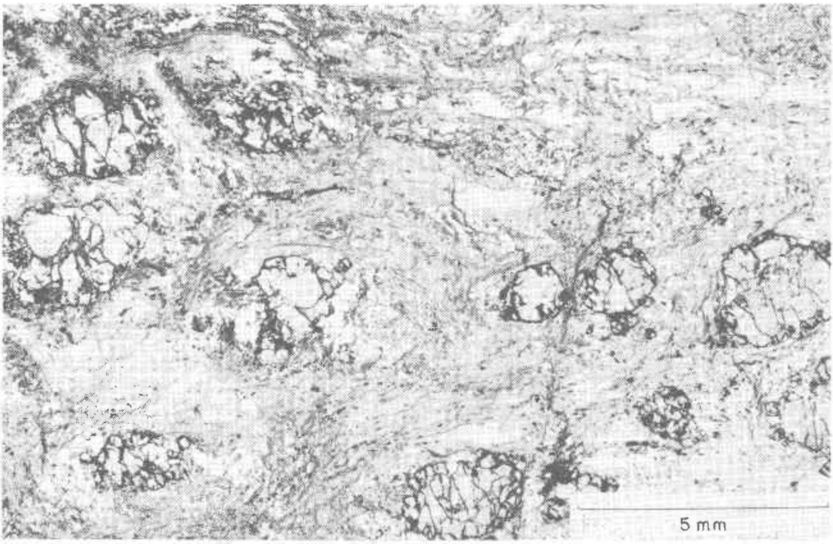


Figure 2. Photomicrograph of garnetiferous sillimanite-mica schist (R-3306) from east side of State Road 695, west of Hairston School. Mica is bent around large fractured garnet porphyroblasts. Plain light.

QUARTZITE

Quartzite occurs as thin beds (0.5 to 2 feet thick), within both the sillimanite-mica schist and the biotite gneiss, which are in general not traceable for more than a few hundred yards (Plate 1). At one location, about 0.5 mile southwest of the intersection of U. S. Highways 58 and 220, a bed of quartzite is continuous across the contact between the biotite gneiss and sillimanite-mica schist. Another typical exposure (Plate 1, R-3344) is along the tracks of the Norfolk and Western Railway in the southwest section of Martinsville, 1 mile rims composed of chlorite, and alteration to either hematite or chlorite has proceeded along fracture boundaries within the porphyroblasts. Rosettes of clinochlore have been observed (R-3358) and probably represent garnets completely altered to chlorite. In addition, a pale-green to colorless muscovite occurs as subhedral to euhedral porphyroblasts containing numerous inclusions, and is oriented with its major axis at an angle to foliation. Most of the opaque grains are euhedral dipyramidal crystals of magnetite. Some are associated with chlorite and are products of alteration of iron garnet, and to a lesser extent, biotite.



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The quartzite is a light- to dark-gray, dense, fine-grained, equigranular rock with a glassy appearance. In hand specimen it seems to be composed predominantly of quartz, but also contains grains of feldspar, mica, and garnet. Individual grains are difficult to distinguish. The rock is generally banded; on weathering this banding becomes more obvious, and resembles sedimentary bedding. With an increase in mica, the rock becomes schistose. On weathering, it becomes friable and decomposes into brown iron oxide-stained quartz sand. The quartzite is extremely resistant to erosion, but is such a minor unit that it has no particular topographic expression.

In thin section, the quartzite is composed predominantly of quartz which occurs as angular, interlocking grains, many of which show strain shadows. Plagioclase is next in abundance, and is either calcic oligoclase or sodic andesine (An_{19-34}). Much of the plagioclase is altered to sericite and kaolinite. Large, euhedral garnet porphyroblasts occur as aggregates in several quartzite samples, and in one sample (R-3303, Figure 3) outline the foliation of the rock. Mica,

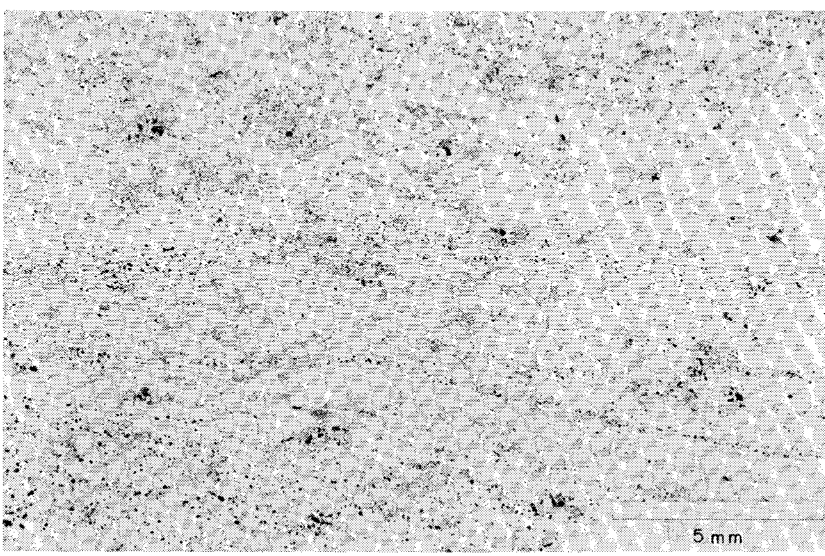

Figure 3. Photomicrograph of garnetiferous quartzite from thin bed of quartzite in sillimanite-mica schist 1 mile north of the intersection of U. S. Highway 58 and State Road 687 at Horse Pasture. Foliation is outlined by concentration of garnet and opaque minerals. Plain light.

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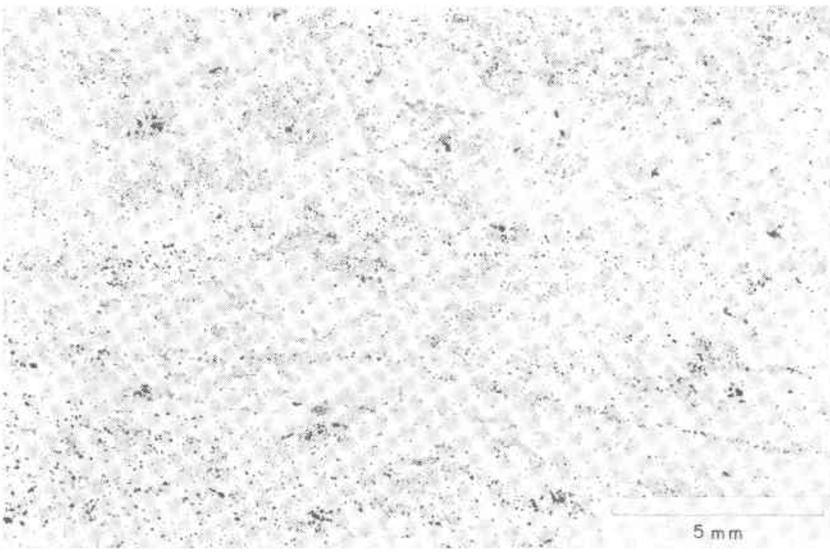

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both biotite and muscovite, occurs as laths parallel to foliation. Opaque minerals are generally present, and clinozoisite is a common alteration product of feldspar.

BIOTITE GNEISS

Biotite gneiss underlies much of the central portion of the quadrangle. It is in contact with the sillimanite-mica schist throughout much of the area, and these contacts are gradational. Relict crystals and bands of sillimanite occur within the biotite gneiss near its contact with the schist. Contacts between the biotite gneiss and the granite gneiss, Leatherwood granite, and Rich Acres Norite are generally sharp. The biotite gneiss is present as undigested remnants in all three of these units. Biotite gneiss is not particularly resistant to weathering, and good exposures are rare except along Jordan Creek, 1 mile south of Fieldale; east and south of Riverside Church; along Smith River south of Koehler; near the power-plant dam south of Martinsville; in the Wilson Quarries, Plant No. 1; in the Martinsville Stone Corporation quarry; and in the abandoned quarry located 2 miles north-northwest of Collinsville.

The biotite gneiss is a light- to dark-gray, compositionally banded, rudely foliated, fine- to coarse-grained, equigranular to inequigranular rock. Banding is produced by white to light-gray bands of granitic rock composed of quartz, feldspar, and to a lesser extent garnet, alternating with dark-gray bands rich in biotite. These alternating compositional bands range from 0.5 to 12 inches in thickness and average about 6 inches. The biotite grains are oriented parallel to foliation, and biotite-rich bands, when viewed normal to this surface, have a shiny black appearance from the oriented mineral grains. Pearly-gray feldspar porphyroblasts, ranging in size from 5 mm to 15 mm, are generally present in the granitic bands of the gneiss. It weathers to a characteristic pink saprolite and develops a brown sandy soil.

In thin section, the rock is composed of, in order of abundance: quartz; plagioclase; biotite; potassic feldspar; mica, including muscovite and sericite; epidote; garnet; opaque minerals, generally magnetite; and traces of sillimanite, hornblende, chlorite, zircon, spinel, actinolite, and clinozoisite. Quartz is the dominant mineral in the biotite gneiss and occurs in either anhedral or subhedral form. Much of the quartz shows strain shadows and Boehm lamellae. Some of the larger grains contain needle-like inclusions of rutile and sillimanite, and the contacts of many large grains are sutured (Figure 4). Andesine (An_{31}) is next in abundance and ranges from anhedral to euhedral in form. Albite twinning is the most common type, although carlsbad twinning is present and pericline twinning is rare. Andesine has been partially or wholly altered to sericite in about one-third of the samples examined, but, in some grains, the altered relict albite and carlsbad twinning remain to such an extent that the anorthite content of the original plagioclase can be determined. Vermiform quartz and potassic feldspar are intergrown with plagioclase along some grain boundaries. Potassic feldspar is present as microcline, microperthite, and myrmekite, most of which is untwinned. Much of the microcline occurs as large porphyroblasts.

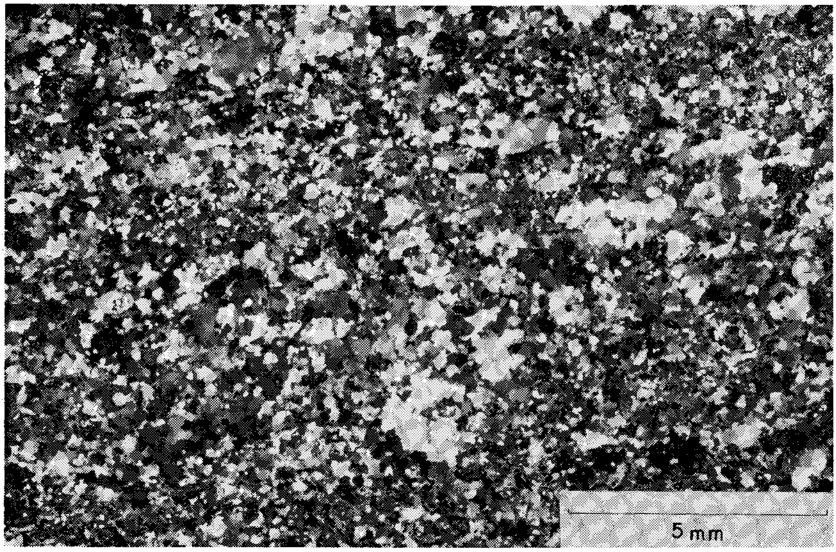
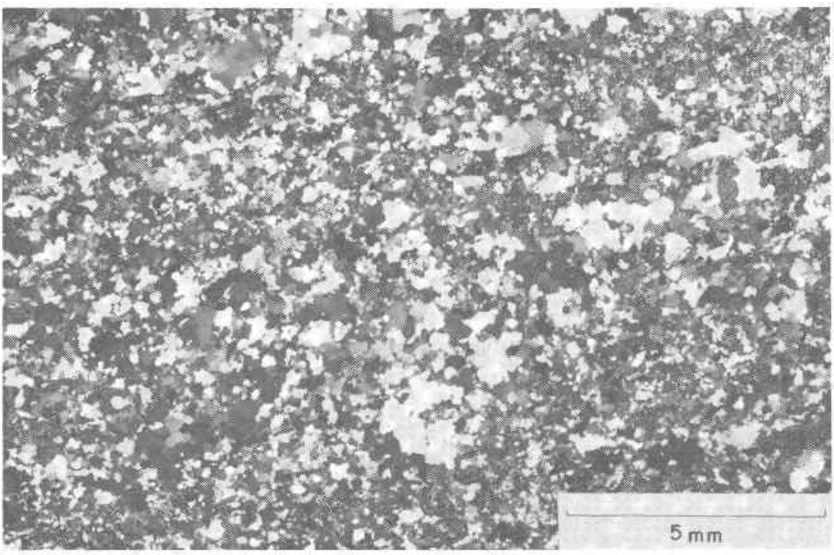


Figure 4. Photomicrograph of biotite gneiss from east side of State Road 684, 0.5 mile south of Fieldale. Gneissic texture is due to layers of coarse-grained quartz and potassic feldspar alternating with finer grained quartz, biotite, and plagioclase. Larger quartz grains have sutured boundaries. Cross-polarized light.

Biotite is present throughout the rock and is concentrated along biotite-rich bands. It occurs as laths that are strongly oriented parallel to foliation. Muscovite, garnet, and opaque minerals (generally magnetite) are important accessory minerals. Sillimanite and hornblende are present as inclusions in feldspars in a few samples. Secondary minerals and the contacts of many large grains are sutured (Figure 4). Andesine (An_{31}) is next in abundance and ranges from anhedral to euhedral in form. Albite twinning is the most common type, although carlsbad twinning is present and pericline twinning is rare. Andesine has been partially or wholly altered to sericite in about one-third of the samples examined, but, in some grains, the altered relict albite and carlsbad twinning remain to such an extent that the anorthite content of the original plagioclase can be determined. Vermiform quartz and potassic feldspar are intergrown with plagioclase along some grain boundaries. Potassic feldspar is present as microcline, microperthite, and myrmekite, most of which is untwinned. Much of the microcline occurs as large porphyroblasts.



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AMPHIBOLITE

Most of the amphibolite occurs within the outcrop area of the granite gneiss, but one persistent amphibolite body is in contact with the granite gneiss, the biotite gneiss, and the sillimanite-mica schist in the area north of Rangeley, and continues to the south along the contact between biotite gneiss and sillimanite-mica schist for several miles (Plate 1). A good exposure of this unit is present south of the abandoned railroad grade along Jordan Creek, 1.5 miles south of Fieldale (Plate 1, R-3287).

Amphibolite is not particularly resistant to weathering and upon exposure is reduced to the heavy red-brown spongy saprolite and heavy clay soil characteristic of mafic rocks. It does hold up the crests of some low ridges in the northwest corner of the quadrangle, probably due to the development of this clay soil which is impervious to water and protects it from agents of chemical weathering and erosion.

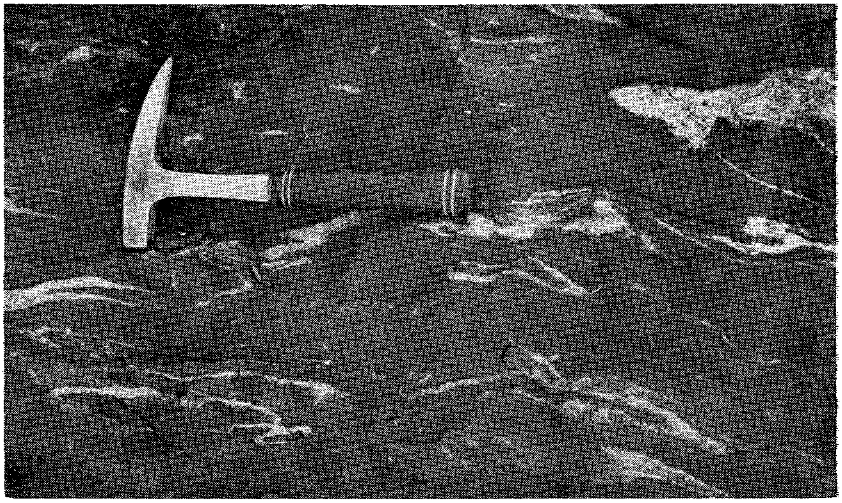

Figure 5. Contorted amphibolite on south side of State Highway Alternate 57 due west across the Smith River from Stanleytown. Mineral segregation has formed hornblende-rich bands alternating with bands composed predominantly of feldspar.

The amphibolite is a dark-gray to greenish-black, generally foliated, fine- to coarse-grained rock which on visual inspection appears to be include chlorite, formed by the alteration of biotite and sericite; epidote; and clinozoisite, formed by the alteration of plagioclase.

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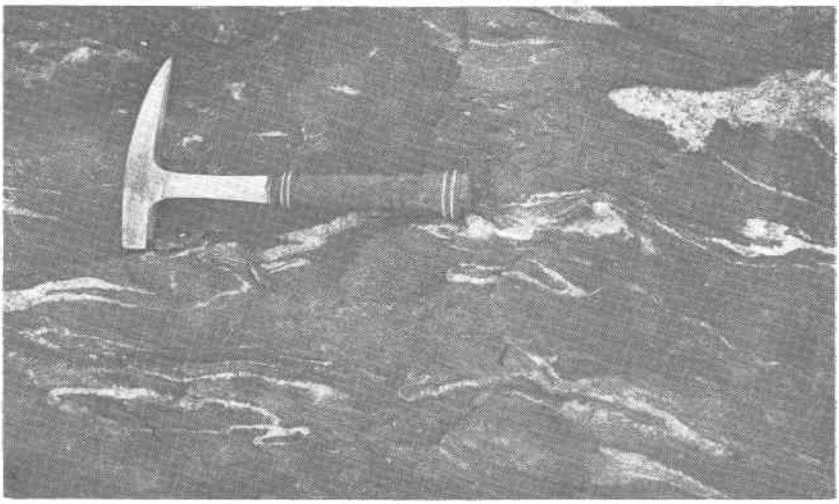

Figure 5. Contorted amphibolite on south side of State Highway Alternate 57 due west across the Smith River from Stanleytown. Mineral segregation has formed hornblende-rich bands alternating with bands composed predominantly of feldspar.

The amphibolite is a dark-gray to greenish-black, generally foliated, fine- to coarse-grained rock which on visual inspection appears to be composed of hornblende and feldspar. The rock is normally equigranular, but larger than average grains of both hornblende and feldspar can be found in almost any exposure. The amphibolite is segregation banded and contains alternating lighter layers composed predominantly of feldspar, and darker layers composed predominantly of hornblende. The hornblende crystals are generally oriented with their long axes in the plane of foliation, although they do not seem to be particularly oriented in any direction on this surface. The rock has been strongly deformed and contains well-developed small ptygmatic folds a few inches across (Figure 5).

In thin section, the rock is composed of, in order of abundance: hornblende, plagioclase, potassic feldspar, biotite, hypersthene, quartz, opaque minerals, chlorite, and trace amounts of zircon, epidote, and actinolite. Hornblende, the major mineral in the amphibolite, occurs as subhedral to euhedral grains. It is quite pleochroic and the colors range from green to brown, indicating that it formed at the highest grade of the amphibolite facies (Miyashiro, 1961, p. 243). In one thin section (R-3287) hornblende occurs as a partial reaction rim around diopside and hypersthene. The plagioclase in the amphibolites averages labradorite (An_{50}) in composition, and ranges from small euhedral grains to large, anhedral porphyroblasts. Carlsbad and albite twinning are the common forms present in most plagioclase grains. Inclusions of zircon, sphene, opaque minerals, and unidentified rod-shaped minerals are common in the larger plagioclase grains. Quartz and opaque minerals, generally magnetite, are the major accessories.

GRANITE GNEISS

Light-gray, rudely foliated, medium-grained, inequigranular granite gneiss underlies the northwestern one-fourth of the quadrangle. This rock makes up the axial portion of the major synclinal structure in the area, and is almost wholly in contact with biotite gneiss along its perimeter except northwest of Fieldale and at Hairston School, where it is in contact with sillimanite-mica schist, and one area north of Preston where it is in contact with Leatherwood granite. Contacts with the older country rock are generally sharp, although masses of biotite gneiss are contained within the granite gneiss. Typical exposures (Plate 1, R-3321, R-3322) can be seen just northwest of Stanleytown.

The granite gneiss weathers to reddish-brown saprolite and develops light reddish sandy soil. Topography of areas underlain by the gneiss consists of low rolling hills. The minor drainage and topography developed on the gneiss in general reflect regional foliation, whereas Smith River and its tributaries, Jordan Creek and Rangeley Creek, cross foliation.

The minerals most easily recognizable in hand specimens of the granite gneiss are quartz, feldspar, biotite, and muscovite. Gneissic texture is produced by a strong planar orientation of mica and, to a lesser extent, by segregation of minerals into alternating bands. These bands range in thickness from 0.2 inch to 3 inches, and are composed of almost pure biotite alternating with quartz and feldspar. These micas, especially muscovite, are sheared out parallel to a planar surface and produce an incipient foliation in the rock.

The rock ranges from granite to quartz diorite, but averages a quartz-monzonite in composition. In thin section, the rock is composed of, in order of abundance: quartz, oligoclase (An_{26}), biotite, and microcline. Epidote, zircon, opaque minerals, sericite, and clinozoisite occur as accessories. Quartz grains show strain shadows and some have developed Boehm lamellae; rarely, the grains are fractured. Some grains have sutured boundaries. Microcline occurs as anhedral crystals generally larger than the groundmass. These crystals contain vermiform inclusions of quartz and have replaced pre-existing quartz grains around mutual boundaries. The microcline also contains perthitic intergrowths of plagioclase. Muscovite occurs as overgrowths on biotite and as distinct sheared-out crystals that have a pearly luster and have been partly converted to sericite. Sericite, epidote, and clinozoisite are products of the alteration of orthoclase and microcline. Biotite is the predominant dark mineral in the gneiss and occurs as parallel oriented flakes and brown strongly pleochroic grains containing numerous inclusions of opaque minerals.

The granite gneiss contains dispersed individual grains of hornblende and also bands of euhedral to subhedral hornblende porphyroblasts ranging from 2 mm to 6 mm in length in the areas along State Road 709 between Jordan Creek and State Road 607; along State Road 761, 0.5 mile west of the intersection with State Road 609; and near New Bethel Church. Exposures of gneiss along State Road 761 contain both hornblende porphyroblasts and augen-shaped inclusions of epidotized hornblende, ranging in size from 6 inches to 1 foot, oriented parallel to the gneissic structure of the rock. In addition, large skialithic masses of amphibolite occur in the granite gneiss along Rangeley Creek, Rock Run, and Blackberry Creek. These inclusions and the presence of hornblende porphyroblasts in the rock in some localities suggest that the parent magma of the gneiss invaded a country rock composed in part of hornblende.

TREMOLITE-TALC SCHIST

The tremolite-talc schist occurs in small elongate discordant bodies intrusive into the granite gneiss. These bodies are found in profusion in two localities, one near Stanleytown and the other west and southwest of Rangeley. A typical exposure of the schist (Plate 1, R-3307) occurs 1 mile southwest of Rangeley and 0.5 mile northwest of the junction of State Roads 667 and 683. The tremolite-talc schist is a light-green to dark gray-green, fine- to medium-grained rock in which tremolite, talc, and chlorite can be distinguished with the unaided eye. Composition is variable throughout the schist bodies, and ranges from zones of almost pure talc, tremolite, or chlorite to various mixtures of the three minerals. A definite zoning was not observed, although chlorite seems to be the dominant mineral around the perimeter of the bodies. The schist bodies are cut by numerous small quartz-feldspar pegmatites ranging from 1 to 4 inches in width. Reaction rims along the contacts show that the pegmatites have converted the tremolite-talc schists to vermiculite. The tremolite-talc schists weather to a dark-brown, heavy, sticky clay only a few feet thick. It is formed by the decomposition of minerals in the schist, and acts as a cap to protect the rock from further weathering.

In thin section, the rock is composed of, in order of abundance: talc, tremolite-actinolite, chlorite, and opaque minerals; some specimens contain serpentine, vermiculite, and quartz. Talc, the dominant mineral, occurs as finely disseminated matrix material, but a few larger subhedral porphyroblasts are present. Tremolite, and in a few cases actinolite, is the next most abundant mineral. These amphiboles are seen in thin section in various stages of alteration to chlorite and talc. Chlorite, generally penninite, and serpentine, occurring as antigorite, are the most common alteration minerals. Vermiculite is present in only one thin section (R-3417), although it commonly occurs in outcrop where the schists are cut by pegmatites. Opaque minerals, mostly magnetite, are present in many samples, and occur as elongate aggregates of grains oriented parallel to foliation.

One ultramafic rock sampled near Stanleytown (Plate 1, R-3324) is composed of 57.0 percent hornblende, 31.0 percent hypersthene, 8.5 percent magnetite, 2.0 percent talc, and 1.5 percent spinel. It is the only sample collected from the Martinsville West quadrangle that may indicate that the original composition of the schist was a metamorphosed pyroxenite.

LEATHERWOOD GRANITE

The Leatherwood granite was first named on the Geologic Map of Virginia (Virginia Geological Survey, 1928) and described as a biotite-muscovite granite with porphyritic facies. The rock was assigned a Precambrian age and was considered to be intrusive into the Glenarm series. Pegau (1932, p. 29) stated: "The Leatherwood granite is named from Leatherwood, the home of Patrick Henry near Martinsville. . . ." Because no type locality was ever described, the exact lithology of this unit is in doubt. However, the name is entrenched in the literature and is used by local quarrymen for the porphyritic granite in the area. The Leatherwood is best exposed in an abandoned quarry (Plate 1, No. 3; R-3310-12) north of U. S. Highway 58, about 2 miles west of Horse Pasture.

The Leatherwood of this report is a coarse- to medium-grained, porphyritic, light-gray biotite granite (Figure 6). In hand specimen the rock contains large phenocrysts of pearly-gray and pale-pink, cloudy, carlsbad-twinned feldspar ranging in length from 5 to 25 mm. It also contains aggregates of black biotite ranging in size from 5 to 13 mm which give the rock a spotted appearance. Quartz occurs as aggregates of saccharoidal smoky-gray grains ranging in size from 5 to 25 mm. The matrix is white, equigranular, and so fine grained that

Figure 6. Leatherwood granite in abandoned quarry north of U. S. Highway 58, 2 miles west of Horse Pasture.

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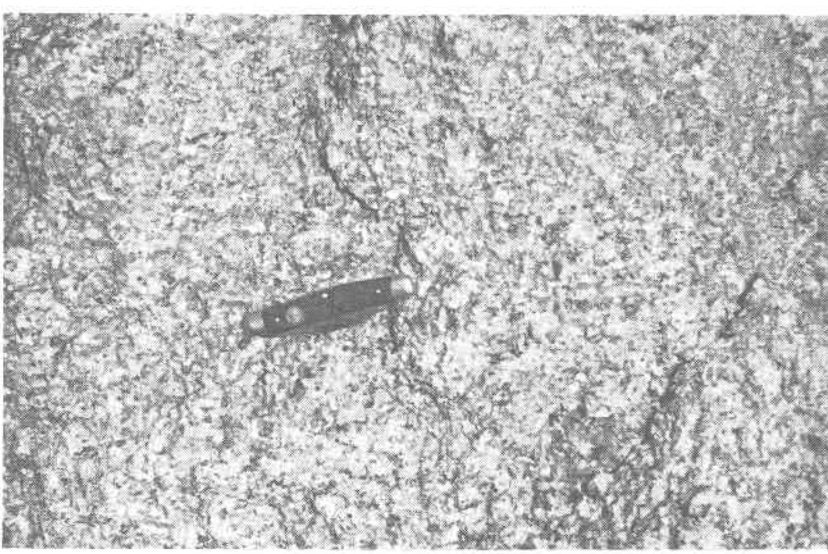

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individual crystals can be distinguished by the unaided eye only with difficulty. Near its borders, the rock is more porphyritic and has a sub-gneissic texture produced by rudely oriented aggregates and streaks of biotite (Figure 7). Toward the centers of larger bodies of the rock, it is less porphyritic, less gneissic, and more equigranular. It occurs in large plutons in the northeastern, southeastern, and southwestern parts of the quadrangle. In addition, a number of small plutons are scattered throughout the central part of the quadrangle. The granite has intruded the sillimanite-mica schist, the biotite gneiss, and granite gneiss. The Leatherwood weathers to a pinkish saprolite and light-tan to red sandy soils. It is expressed topographically as low convex hills and V-shaped valleys. The drainage pattern developed on this rock is rather coarse, and is marked by the absence of tributaries to the trunk streams.

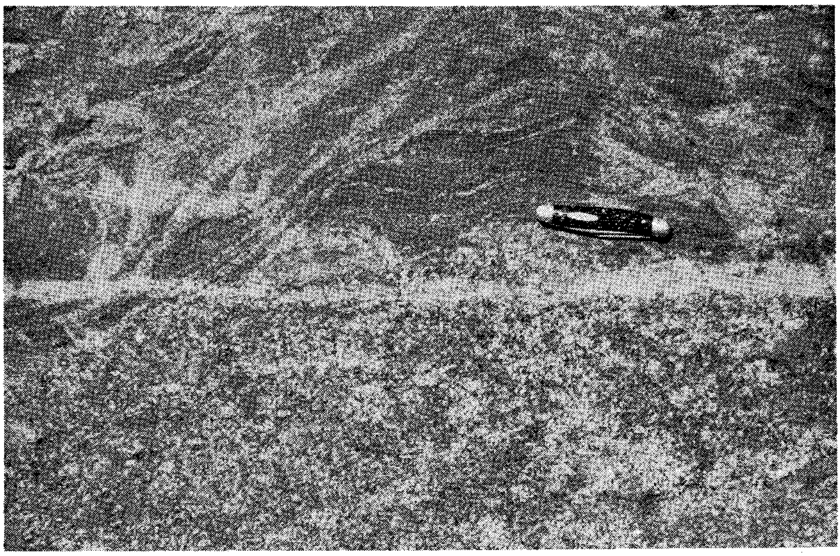

Figure 7. Contact between fine-grained, foliated, contorted biotite gneiss and coarse-grained, porphyritic Leatherwood granite at southern city limits of Martinsville, north of road to Du Pont plant, about 200 yards west of U.S. Highway 220. A narrow pegmatite dike near the center of the photograph cuts across the contact.

Contacts with the country rock are distinct in most places, although the enclosing rock has generally been feldspathized by the addition of plagioclase to the groundmass and the growth of large subhedral, zoned, carlsbad-twinned microcline porphyroblasts. In some exposures individual crystals can be distinguished by the unaided eye only with difficulty. Near its borders, the rock is more porphyritic and has a sub-gneissic texture produced by rudely oriented aggregates and streaks of biotite (Figure 7). Toward the centers of larger bodies of the rock, it is less porphyritic, less gneissic, and more equigranular. It occurs in large plutons in the northeastern, southeastern, and southwestern parts of the quadrangle. In addition, a number of small plutons are scattered throughout the central part of the quadrangle. The granite has intruded the sillimanite-mica schist, the biotite gneiss, and granite gneiss. The Leatherwood weathers to a pinkish saprolite and light-tan to red sandy soils. It is expressed topographically as low convex hills and V-shaped valleys. The drainage pattern developed on this rock is rather coarse, and is marked by the absence of tributaries to the trunk streams.

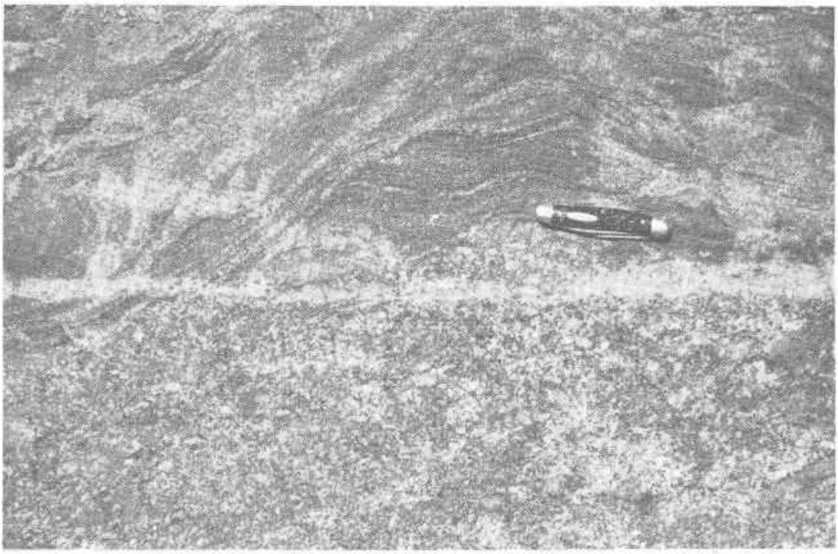

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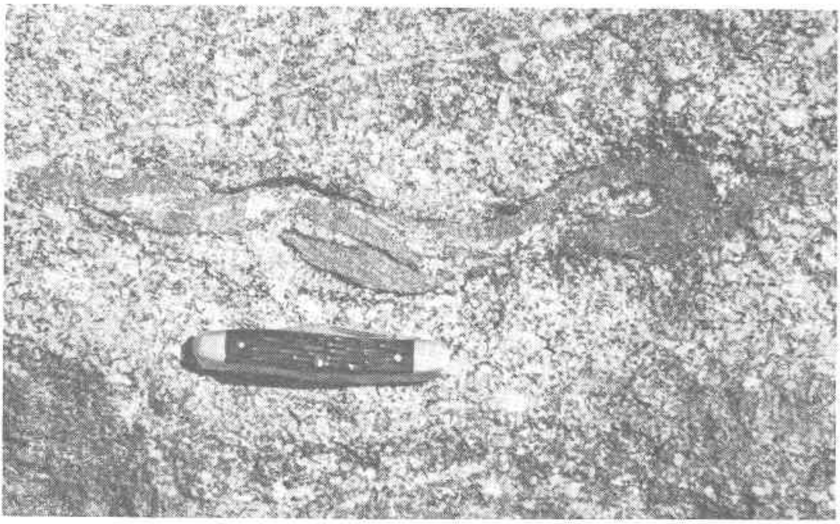
Figure 8. Plastically deformed inclusion of biotite gneiss in sill-like body of Leatherwood granite just south of Martinsville city limits along left bank of Smith River, 0.4 mile northwest of power-plant dam.

The Leatherwood is compositionally a granite, although in some areas it becomes a granodiorite, probably due to contamination of the magma by assimilation of more mafic country rock. In thin section, the rock contains, in order of abundance: quartz, potassic feldspar, plagioclase (An_{27}), and biotite. Accessory minerals, in order of abundance, are: opaque minerals, generally magnetite; epidote; albite; zircon; hornblende; muscovite; sphene; and garnet. Quartz occurs as interlocking grains that generally show strain shadows and Boehm lamellae. Some quartz grains are internally fractured, and others are embayed by microcline crystals along grain boundaries. Unidentified hair-like inclusions are prevalent in some grains. Oligoclase is the major feldspar in the matrix of the rock. Although microcline occurs as anhedral crystals in the groundmass, it is predominantly found as large subhedral to anhedral phenocrysts. These phenocrysts contain vermiform quartz inclusions, and are in part perthitic. Albite, althe feldspars are concentrated along foliation planes of the country rock, producing migmatite banding. Where this occurs plastic deformation of the country rock is also much in evidence. Deformed inclusions of country rock are common in these migmatite bands and near the periphery of granite bodies (Figure 8).



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RICH ACRES NORITE

The Rich Acres Norite is named for an exposure (Plate 1, R-3340, R-3382) 150 feet northwest of the Rich Acres Christian Church in the Rich Acres community in the southeastern part of the quadrangle. The norite is exposed in several distinct plutons in the quadrangle which include its type locality at Rich Acres in the southeastern part, at Villa Heights and north of Villa Heights in the northeastern part, at Collinsville in the north-central part, east of Stanleytown in the northern part, and a small pluton on a tributary of Shelton Branch in the southwestern part.

The norite is an intermediate to dark greenish-gray, porphyritic, nonfoliated, coarse-grained rock. In hand specimen, feldspar, biotite, and orthopyroxene can be identified. Feldspar is the most abundant mineral and occurs as light-gray, cloudy, subhedral to euhedral phenocrysts that range from 5 to 20 mm in length. Orthopyroxene having a bronze schiller is dispersed through the rock as crystals that are rarely over 5 mm in length. The matrix is equigranular and composed of crystal aggregates of biotite and feldspar.

The norite has intruded sillimanite-mica schist, biotite gneiss, granite gneiss, and Leatherwood granite. The contact with older rocks is almost a hairline. The norite plutons range from irregular and elliptical masses to elongate and arcuate intrusions that roughly follow foliation trends; however, along the eastern edge of the quadrangle it has intruded the center of two Leatherwood granite plutons leaving a partial band of granite surrounding a norite core.

The norite is easily weathered and fresh rock has been observed at only a few places. The best localities are the type section northwest of Rich Acres Church (Plates 1, R-3340, R-3382) and behind the Fieldale-Collinsville High School (R-3398, R-3399). The rock develops spheroidal weathering rinds and decomposes into a thick mantle of light-brown saprolite containing scattered ocherous spots caused by weathering of iron-bearing minerals. Soils developed on the norite are tan to dark-umber plastic clays. Areas underlain by the norite have a subdued topography due to its susceptibility to chemical weathering and generally are lowlands in which the major drainage is located. Streams flowing over this rock type in general have developed broad flood plains that range in maximum width from 0.2 mile along Beaver Creek to 0.6 mile along Smith River southeast of Stanleytown.

The rock averages a norite in composition, although some isolated outcrops contain from 10 to 21 percent quartz, making them quartz norites. Minerals observed in thin section are: plagioclase (An_{60}), hypersthene, hornblende, biotite, opaque minerals (mostly ilmenite), chlorite, and microcline. Accessory minerals include orthoclase, quartz, zircon, diopside, augite, garnet, albite, antigorite, anthophyllite, olivine, spinel, calcite, actinolite, talc, sericite, and epidote. The rock has a subophitic to granular-porphyritic texture. Lath-shaped plagioclase fills the interstices left by the earlier formed orthopyroxene; it has an average composition of labradorite, although bytownite has been identified in at least one-third of the samples examined. One sample of norite collected southwest of Firestone (R-3339, Figure 9) contains large olivine phenocrysts surrounded by reaction coronas composed (from inside to outside) of hypersthene, partially altered to

Figure 9. Photomicrograph of Rich Acres Norite (R-3339) from 0.6 mile southwest of the junction of State Roads 682 and 907. Olivine grain near the center is partially surrounded by successive reaction rims of hypersthene and hornblende, some of which is partially altered to chlorite. Cross-polarized light.

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hornblende, in turn partially altered to chlorite. The hypersthene occurs as brown, faintly pleochroic, anhedral crystals that are partially altered to diopside, augite, and chlorite. Enstatite containing numerous inclusions too small to be identified optically is also present.

Much of the hornblende has been identified optically and by X-ray diffraction to be pargasite. This variety of hornblende has not been previously reported in Virginia. It occurs as olive-green anhedral to subhedral crystals that are associated with hypersthene and enstatite. Some crystals of pargasite contain inclusions similar to those in the enstatite and might be relict from alteration of the enstatite.

Two kinds of biotite have been observed: a greenish-brown iron variety and a red-brown titanium variety that contains rutile needles. The greenish-brown biotite occurs as alteration masses surrounding hypersthene and as crystals in the groundmass, whereas the brown variety occurs as isolated porphyritic crystals in the groundmass. Quartz, if present, occurs in the groundmass as amoeboid-shaped masses that show strain shadows; some contain Boehm lamellae. It seems to be a late mineral to crystallize in the matrix of the rock and fills the interstices between the pyroxene and feldspar, rather than replacing previously formed minerals. Local late-stage replacement of the norite is suggested by the presence of microcline crystals containing intergrowths of unstrained vermiform quartz around their boundaries. The conversion of biotite to chlorite, and pyroxene to antigorite and actinolite, in some samples further indicates deuteric alteration of the rock.

PEGMATITE DIKES

Dikes that range in width from several inches to about 15 feet cut most of the rock units in the quadrangle (Plate 1). These pegmatites (Figure 10) are randomly oriented, and are not persistent along their strike. The mineralogy of most pegmatites is uniform throughout, but a few zoned pegmatites are present. These have a core of massive quartz that generally encloses large perthite crystals. Surrounding the core is a coarse-grained intergrowth of feldspar, quartz, and muscovite, which is equivalent to the "wall zone" (Cameron and others, 1949).

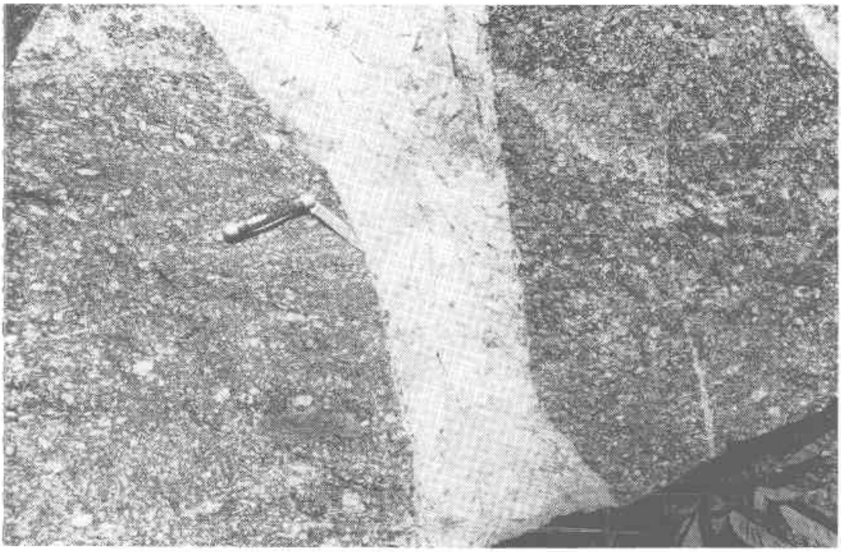
Feldspar is the dominant mineral in most of the pegmatites. Microcline is the common feldspar, but in a few pegmatites plagioclase is more abundant. A modal analysis of one sample of plagioclase-rich pegmatite (R-3334) is as follows: oligoclase, 47 percent; microcline, 32 percent; biotite, 11 percent; quartz, 5 percent; muscovite, 3 per-

Figure 10. Quartz-feldspar pegmatite dike cutting porphyritic biotite gneiss that has been feldspathized by Leatherwood granite. Exposure is located just south of Martinsville city limits, along the left bank of Smith River, 0.2 mile northwest of power-plant dam.

cent; and opaque minerals, 2 percent. The microcline-rich pegmatites average about 40 to 60 percent microcline, 20 to 40 percent quartz, and 10 to 30 percent muscovite. Muscovite is an important constituent in most pegmatites, and occurs as small crystals ranging in size from 4 to 30 mm. However, the pegmatites that cut the Leatherwood granite and Rich Acres Norite are generally poor in muscovite. Likewise, Overstreet and Bell (1965, p. 37) have observed that pegmatites cutting the igneous rocks of the Charlotte belt in South Carolina are also relatively free of muscovite.

DIABASE DIKES

All the diabase intrusions mapped in the quadrangle occur as vertical dikes that can be traced as straight lines along strike. The dikes average approximately 20 feet in width, although one dike south of Fieldale (Plate 1) is 350 feet wide. The diabase is a dark-gray to black, fine- to medium-grained, equigranular to inequigranular rock. It is only moderately resistant to chemical weathering and occurs in the form of exfoliated, spheroidally weathered boulders on the surface of the ground. For this reason diabase dikes are generally difficult to



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The diabase is composed mainly of calcic plagioclase (labradorite, An_{56}) and clinopyroxene, generally augite. It has a fine-grained subophitic to ophitic texture, with larger augite crystals enclosing and occurring interstitially with labradorite laths. Magnetite is the only important accessory mineral. In one thin section (R-3353) quartz and orthoclase were observed to be intergrown as a result of the micrographic replacement of plagioclase around the grain boundaries. Hornblende, chlorite, and sericite are other alteration minerals present in the diabase.

It has been noted that most of the dikes taper and become wedge shaped at their ends. Some of the dikes wedge in a vertical direction as well, and have been traced vertically to where they taper out near the tops of hills; these dikes are present on the other sides of the hills at approximately the same elevation and can be traced down the slopes. This wedging in a vertical direction has been noted in two separate dikes, one cropping out along the Smith River at the southwestern limits of Martinsville, and a second cropping out along the hill adjacent to Jordan Creek south of Fieldale.

The diabase dikes seem to be independent of pre-Triassic regional structure. Although there are numerous local exceptions, the dikes seem to be part of a fan-shaped swarm made up of three distinct groups, each with its own orientation; those in the western and southwestern parts of the quadrangle have a trend of N.20°W., those in the central part have a trend of N.5°W., and those in the eastern part have a trend of N.30°E. The vertical orientation and linear trend of the dikes suggest that they are filling tension gashes. Since these cracks are not associated with surface structure, they probably developed normal to the smallest principal stress, due to release of pressure at depths which involved and probably caused melting of the mafic rocks of the mantle. A crack, once formed and invaded by magma, can be held open by the hydrostatic pressure of the magma, and the crack may be extended upward by the wedging effect of the magmatic fluids (Anderson, 1942). The diabase dikes that wedge out vertically probably represent solidified magma wedges. The fact that most of the dikes also taper to a point horizontally suggests that the tension cracks were being enlarged laterally as well as vertically.

TERRACE DEPOSITS

Remnants of major fluvial deposits are preserved as flat-topped terraces throughout the quadrangle. The two largest terrace deposits occur along the Smith River; one underlies the DuPont plant southwest of Martinsville and the other underlies Fieldale. The lower portion of most terraces is a white gravel, overlain by a white kaolinitic clay. An auger hole (Plate 1, R-3424) encountered stratified silt and fine sand underlain by white kaolinitic clay, grading downward into well-stratified sand and gravel beds. The gravels are generally composed of subrounded to well-rounded quartz pebbles and cobbles up to 8 inches in diameter (Figure 11). The thickness of the terraces is on the order of a few tens of feet. The surfaces of the terraces are from 20 to 80 feet higher than the present level of drainage, and decreases in elevation downstream at approximately the same rate as present-day drainage.

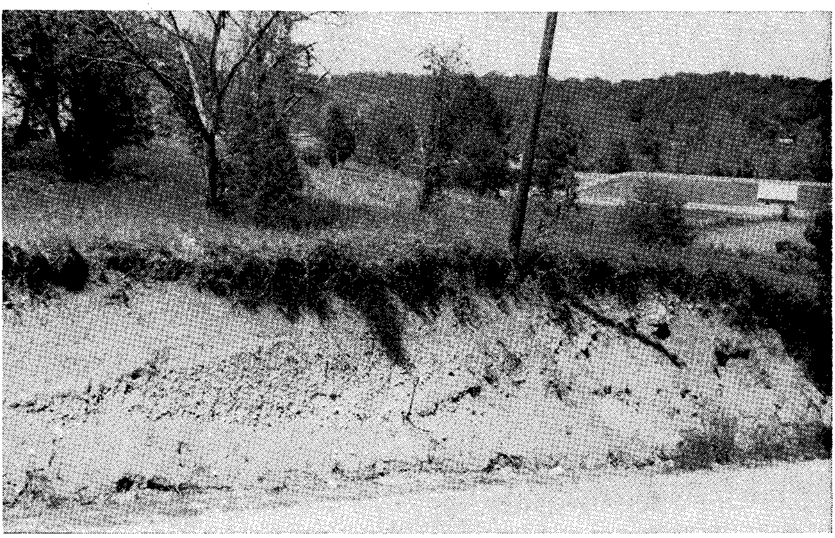

Figure 11. Terrace deposit southwest of Smith River along State Road 907, 0.3 mile southwest of its junction with State Road 682. Coarse gravel beds overlie saprolite developed on Rich Acres Norite, and are overlain by unstratified silts and sands.

COLLUVIUM

Deep-red colluvial deposits occur on the flanks of hills and near the headwaters of small streams throughout the area. These are composed of an unsorted mixture of angular rock fragments, fine sand,

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Figure 11. Terrace deposit southwest of Smith River along State Road 907, 0.3 mile southwest of its junction with State Road 682. Coarse gravel beds overlie saprolite developed on Rich Acres Norite, and are overlain by unstratified silts and sands.

COLLUVIUM

Deep-red colluvial deposits occur on the flanks of hills and near the headwaters of small streams throughout the area. These are composed of an unsorted mixture of angular rock fragments, fine sand, silt, and clay. Generally interbedded with this unsorted material are lenses of roughly stratified sand and silt, probably sheet-wash deposits. The rock fragments in these deposits are generally angular, and from their composition were derived from local bedrock. Some of them are concentrated in definite zones that are parallel to the surface of the deposits.

ALLUVIUM

The valley floors of all major streams are filled with alluvial deposits. Many small creeks have narrow bands of alluvium, and the beds of intermittent creeks are floored with sand and gravel. The material composing the base of the alluvium is generally gravel; this gravel is not exposed except in the beds of streams, but was encountered in a hand-auger hole (Plate 1, R-3425). Overlying the gravel is a sandy clay, which is in turn overlain by 6 to 8 feet of gray-blue stratified clay and silt containing much organic matter. This sequence is overlain by unstratified flood-plain material, a poorly sorted, silty to sandy loam, which is the principal alluvial deposit exposed in the area. No complete section of alluvium was found, and the thickness of individual lithologies within the alluvium was not determined.

STRUCTURE

FOLDS

The major structure that underlies almost all of the quadrangle is the skeletal remnant of the east limb and, to the southwest, the nose of a large open syncline. This structure has a total width of about 12 miles, based on preliminary mapping in the adjoining Endicott quadrangle. The axis is in the vicinity of the western edge of the Martinsville West quadrangle, but cannot be more accurately defined due to its obliteration by granite gneiss and Leatherwood granite in the core of the fold. Skialiths of sillimanite-mica schist along the east limb of the fold are elongated parallel to strike and outline the structure; biotite gneiss to a lesser extent also follows regional trends. Foliation can be traced from sillimanite-mica schist through biotite gneiss as can be seen along U. S. Highway 220 both north of Collinsville and at the western city limits of Martinsville, and along the Norfolk and Western Railway in Martinsville, suggesting that the foliation which outlines this structure pre-dates the metamorphism that converted the rocks of the area into schists and gneisses. This could represent a primary foliation in the original sedimentary rocks because contacts between quartzites and sillimanite-mica schists are parallel to regional foliation. Once established, these foliation planes served as avenues for later metasomatism and emplacement of igneous rocks.

Secondary open folds trending parallel to the major syncline are developed on its eastern limb and produce local reversals in dip. In addition, several large chevron folds have developed on the eastern limb of the syncline in the area west of Fieldale. These folds have a westerly plunge toward the axis of the major syncline and are oriented normal to the trace of the axis of this structure. The orientation of these folds indicates that after the syncline had formed, its east limb was subjected to an almost north-south compression, crumpling it into a series of westward- and southwestward-plunging chevrons.

FAULTS

Although numerous small faults with displacements on the order of a few inches and traceable for a few feet were observed, no major faults were discovered during mapping of the quadrangle. Two normal

Figure 12. Normal fault located 0.2 mile south of the junction of State Highway Alternate 57 and State Road 682, about 1 mile south of Stanleytown. Dark terrace deposits on the left are downfaulted into contact wtih saprolite from Rich Acres Norite on the right.

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faults are shown on the geologic map (Plate 1) and are located 0.2 mile south of the junction of State Highway Alternate 57 and State Road 682 about 1 mile south of Stanleytown, and on the southwest side of U. S. Highway 220 across from the Villa Heights community. In each of these, Quaternary deposits have been displaced. The fault south of Stanleytown (Figure 12) has a strike of N.12°E. and a dip of 62°SE. It displaces red alluvial silts with interstratified beds of rounded gravels, 2 to 4 inches thick, down against Rich Acres Norite that underlies the area. Vertical displacement of 15 to 20 feet can be measured along the fault, and it can be traced for about 300 yards along strike. The other fault can be traced for about 100 feet, and has a strike of N.17°E. and a vertical dip. At least 5 feet of vertical movement can be measured on this fault, and downfaulted colluvium rests against Rich Acres Norite and biotite gneiss.

LINEATIONS

Linear features within the rocks of the quadrangle were carefully measured. The bearings of lineations occurring in the plane of foliation are shown on Plate 1. Their angles of plunge can be easily calculated by referring to a chart for computing apparent dip (Billings, 1954, p. 442). The angles of plunge of lineations not oriented in the plane of foliation are shown on Plate 1. Mineral lineations are shown by a different symbol than lineations caused by crinkle folds, boudinage, and rodding.

The quadrangle contains two pairs of lineation directions, one oriented parallel to the tectonic directions of the major synclinal fold in the area and the other parallel to the tectonic directions of the secondary chevron folds developed on the east limb of the major fold. Lineations that coincide with the tectonic *a* direction of the major synclinal structure have an east-west alignment, and those parallel to the tectonic *b* direction have a north-south alignment. The second pair of lineations is oriented either northeast-southwest parallel to the tectonic *a* direction of the secondary folds or northwest-southeast parallel to their tectonic *b* direction. As would be expected, the mineral lineations are in general parallel to tectonic *a* directions, and rodding, boudinage, and minor fold axes coincide with *b* directions.

JOINTS

Joints are developed in all the igneous and metamorphic rocks in the quadrangle. The attitudes of joints were noted during the course

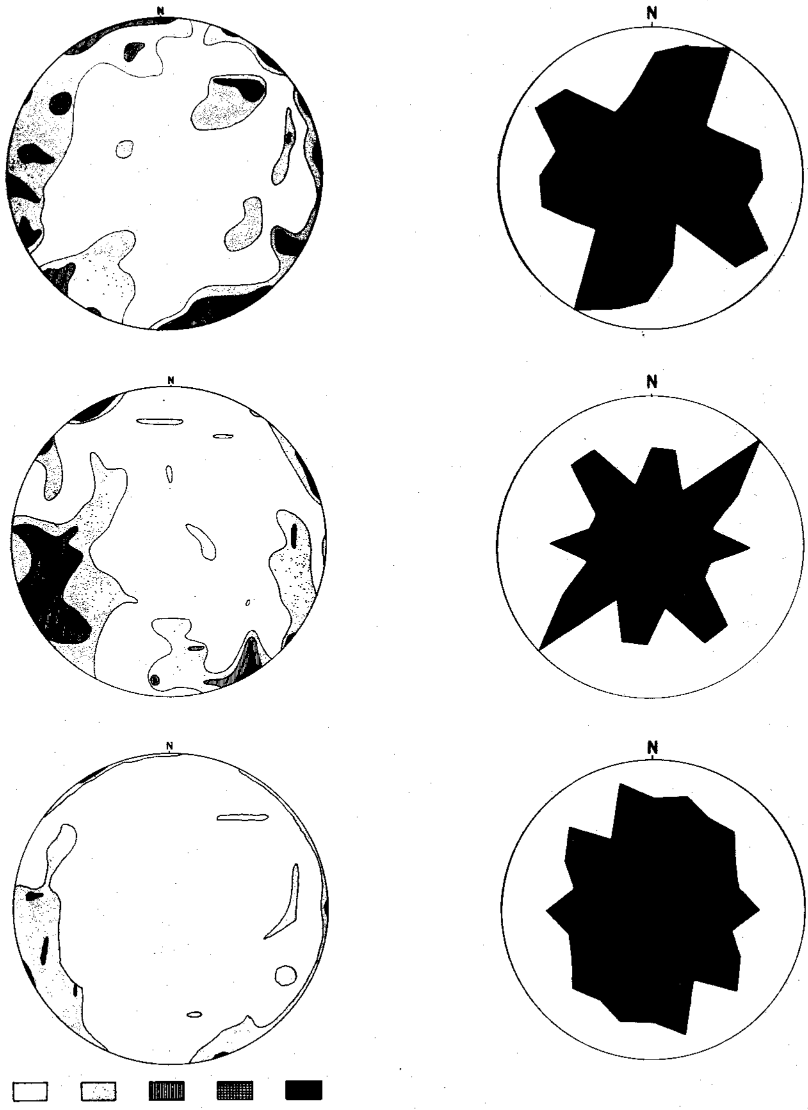

Figure 13. Lower-hemisphere contour diagrams and rose diagrams illustrating the attitudes of joints. Top: sillimanite-mica schist; based on 100 attitudes; circle around rose diagram represents 12 joints. Middle: biotite gneiss; based on 100 attitudes; circle around rose diagram represents 12 joints. Bottom: composite for all units; based on 225 attitudes; circle around rose diagram represents 20 joints.

of field mapping and for interpretation were plotted on lower-hemisphere diagrams and rose diagrams (Figure 13). These diagrams show that the joints are predominantly vertically dipping and indicate little preferred orientation of strike. The only unit that seems to have orientation of joint sets is the biotite gneiss that contains two fairly prominent northeastward-trending sets with vertical dips and two northwestward-trending sets, both having dips to the northeast. The joints do not seem to be related to either the folding or the intrusion of igneous rocks. They are thought to have developed along lines of stress set up after the last period of igneous intrusions.

STATISTICAL CORRELATION

Zircons were concentrated from 10 saprolite samples: four from the Leatherwood granite and two each from the Rich Acres Norite, granite gneiss, and pegmatite dikes. Calculations for the reduced major axes as outlined by Kermack and Haldane (1950), Imbrie (1956), and Larsen and Poldervaart (1957), were made. The reduced major axes for zircons collected from two areas within the outcrop belt of the granite gneiss correlate with each other, and the rounded nature of most of the grains suggests a sedimentary origin for these rocks. Some euhedral elongate zircons in these samples are possibly due to later introduction of material.

Excellent correlation of reduced major axes for zircons from isolated plutons of Leatherwood granite was obtained, indicating that these isolated bodies had a common magma source. The reduced major axes for zircons from two plutons of Rich Acres Norite correlated with each other, and also with all of the samples collected from the Leatherwood granite. The euhedral shape of most of the zircons from these bodies suggests a magmatic origin. These data further suggest that the Leatherwood granite and Rich Acres Norite were derived from the same parent magma and differentiated prior to intrusion. No correlation was possible between the granite gneiss and either the Leatherwood granite or the Rich Acres Norite. The reduced major axes for zircons collected from two separate pegmatites correlate very well with each other, but show no correlation with any samples from other lithologies. Zircons from the pegmatites are elongate and euhedral, indicating a primary first-generation origin.

AGE

Field evidence, zircon correlations, and regional correlations were used to obtain the relative ages of the rock units mapped in the area. No definite age could be assigned to the sillimanite-mica schist, quartzite, biotite gneiss, and amphibolite, but field evidence indicates that they are the oldest rocks in the area. For this reason, the writers tentatively assign a Cambrian or Precambrian age, following in part Jonas (1932) and Pegau (1932) who correlated these rocks with the Wissahickon schist. This age is in harmony with that assigned to metasedimentary rocks in other portions of the inner Piedmont (Overstreet and Bell, 1965, p. 100).

The granite gneiss is tentatively assigned an early Paleozoic age and is thought to have formed during the same period of metamorphism which converted the older country rocks into sillimanite-mica schists, quartzite, biotite gneiss, and amphibolite. The granite gneiss is lithologically and mineralogically similar to the Toluca Quartz Monzonite (Griffitts and Overstreet, 1952, p. 779). An approximate age of 450 million years for the Toluca Quartz Monzonite in North Carolina has been reported (Overstreet and Bell, 1965, p. 102). Tremolite-talc schist is also tentatively assigned an early Paleozoic age. It intrudes, and is younger than, the granite gneiss.

The Leatherwood granite was previously considered Precambrian (Virginia Geological Survey, 1928), early Paleozoic (Richard, 1937), early to middle Paleozoic (Sutherland, 1935), and late Paleozoic (Jonas, 1932, p. 6). King (1955, p. 355) mentioned the correlation between the Leatherwood granite and the Mt. Airy Granite of northern North Carolina. He included these rocks with a group of granites that he considered to be mainly late Paleozoic. The Leatherwood granite is thought to be late Paleozoic and intrudes all of the units here designated as early Paleozoic. The Rich Acres Norite is also considered late Paleozoic, and slightly younger than the Leatherwood granite, because it apparently cuts the granite in an exposure on the south slope of a hill 0.75 mile west-northwest of Christian View Church in the southwestern part of the quadrangle. Furthermore, zircon correlations indicate that the Leatherwood granite and Rich Acres Norite were formed from the same parent magma. The pegmatite dikes in the area are post-Rich Acres in age, and are considered to have been emplaced near the end of the Paleozoic Era. The diabases are similar to those in Triassic basins to the east and north, and are considered to be of Late Triassic age.

GEOLOGIC HISTORY

The rocks in the Martinsville West quadrangle record a long period of geologic time. The first recorded event was formation of a geosynclinal trough over much of what is now the Piedmont, and deposition of high-alumina clay and sand beds in this basin either during Precambrian or Early Cambrian time. Rocks that are now amphibolite were either deposited during this cycle as mafic pyroclastic rocks and lava flows or intruded as mafic sills. The cycle of sedimentation was brought to an end by destruction of the basin at the culmination of a period of major orogeny. During this orogeny, the sedimentary rocks were folded and deeply downwarped. The temperature and pressure at this depth regionally metamorphosed these rocks to the sillimanite-almandine subfacies of the amphibolite facies (Turner, 1948). Portions of the rock were restrictively invaded and metasomatized by solutions rick in sodium and silica, resulting in the formation of biotite gneiss by the development of sodic feldspars and quartz. The facts that foliation planes are traceable from sillimanite-mica shist into biotite gneiss without interruption and that the sillimanite-mica schist grades into the biotite gneiss, both along strike and normal to it, support the interpretation that the biotite gneiss was derived from either the sillimanite-mica schist or the same parent rock by metasomatic replacement. Relict crystals of sillimanite occur in the biotite gneiss at the contacts with sillimanite-mica schist. The outcrop pattern indicates that the solutions that produced the biotite gneiss invaded along pre-existing planes of foliation and, where possible, also took advantage of any fractures normal to foliation. The final products were refractory skialiths of sillimanite-mica schist elongated parallel to foliation and surrounded by biotite gneiss. The mineralogy of the paraschists and paragneisses thus produced generally indicates high-temperature and high-pressure Barrovian-type metamorphism (Winkler, 1965, p. 71).

The presence of the granite gneiss in the axis of the major syncline in the quadrangle suggests that during regional metamorphism, probably culminating at the peak of folding, the sedimentary rocks in the center of the syncline were downwarped to a level where they were fused by anatexis without actually becoming mobilized, thus preserving their original foliation. A similar replacement of rocks in the axis of a large regional syncline by granite has been reported in rocks of the inner Piedmont belt in northwestern South Carolina (Cazeau, 1963, p. 17). The amphibolites in the granite gneiss are probably relict bodies that remained as refractory masses because the melting temperature of these rocks was above the temperature reached during metamorphism. Partial assimilation of the amphibolite must have occurred because augen-shaped masses of amphibolite and individual hornblende crystals are present in the granite gneiss. The hornblende crystals probably formed due to local enrichment in mafic material by assimilation of amphibole.

The close age association of the Leatherwood granite and the Rich Acres Norite, as indicated by field evidence and zircon correlation, suggests that they were formed in the same orogenic cycle. Field evidence suggests that the norite is younger than the granite, and the zircon correlations indicate that they were derived from the same parent magma. Although this differentiation could have taken place in the magma chamber by crystal settling or filter pressing, the higher calcium content of the plagioclases in the later norite does not indicate such an occurrence; if only gravity separation were involved, the composition of the feldspars should become progressively more sodic. A more reasonable explanation would be differential anatectic melting, with rising temperature during a second period of orogeny. During this orogeny minerals of felsic composition, because of their low melting point, would have fused first and intruded the overlying country rocks as a magma producing the Leatherwood granite. With rising temperature as the orogeny culminated, the more refractory mafic constituents would have fused and intruded the country rock and Leatherwood granite to form the Rich Acres Norite. The general presence of a narrow zone of migmatized and feldspathized country rock around the Leatherwood plutons suggests that the country rock was attacked by emanations from the intruding magma.

The rocks in the area have been regionally retrogressed to the greenschist facies, probably during the same period of orogeny that produced the Leatherwood granite and Rich Acres Norite. This metamorphism has affected all rocks within the quadrangle except the diabase dikes of Triassic age. During this metamorphism, biotite, amphibole, and garnet in the sillimanite-mica schist were altered to chlorite, and sillimanite and feldspar were changed to mica. In addition to sericite and chlorite, the biotite gneiss unit contains epidote and clinozoisite derived from the alteration of plagioclase. The tremolite-talc schist is the product of retrograde metamorphism of ultramafic rock that may have originally been pyroxenite. The development of chlorite, epidote, and clinozoisite in the Leatherwood granite and chlorite, serpentine, and actinolite in the Rich Acres Norite probably resulted from late-stage alteration.

During probable Late Triassic time, diabase dikes were emplaced along zones of fracture. Follownig this episode the area was uplifted and eroded almost to its present base level, and valleys were filled with bleached gravels and white kaolinitic clays. A slight second uplift, probably accompanied by some faulting, occurred late in the geologic history of the area. Erosion immediately began and reduced the area to its present base level, leaving the former flood-plain deposits, some of which are displaced by faults, as terraces along the present-day streams. The last event, which is still going on today, is the filling of the stream valleys with flood-plain material and the accumulation of colluvium along the slopes of hills.

ECONOMIC GEOLOGY

STONE

Martinsville Stone Corporation, north of Martinsville, and Wilson Quarries, Plant No. 1, north of Horse Pasture, are presently quarrying and crushing biotite gneiss. The Martinsville Stone Corporation quarry (Plate 1, No. 1) is located on the south side of State Road 882, about 1 mile west of its junction with State Highway 108, about 2 miles north of Martinsville. This quarry was operated by the Virginia Department of Highways from 1947 until 1958, when the present owners began production (Gooch and others, 1960, p. 41). Results of physical tests on rock from this quarry are as follows: Los Angeles loss (Grade A), 24.4; absorption, 0.64; and specific gravity, 2.84 (Gooch and others, 1960, p. 41). The Wilson Quarries, Plant No. 1 is located on the east side of State Road 687, about 0.5 mile north of its intersection with U. S. Highway 58 at Horse Pasture (Plate 1, No. 9). Production began in May 1961, and has continued since that date. Results of physical tests determined on rock from this quarry are: Los Angeles loss (Grade B), 32.2; absorption, 0.21; and specific gravity, 2.91 (Virginia Dept. Highways, 1963). An abandoned quarry in biotite gneiss is located 1.25 miles southeast of the intersection of U. S. Highway 220 and State Highway 57 at Bassett Forks (Plate 1, No. 2).

Samples of biotite gneiss from three prospects within the quadrangle have been tested by the Virginia Department of Highways for use as a potential coarse aggregate (Virginia Dept. Highways, 1954, p. 54). One prospect is just west of State Highway 108, 0.3 mile north of its junction with State Road 714, about 4 miles north of Martinsville. Physical test data are: Los Angeles loss (Grade A), 52.0; absorption, 0.91; and specific gravity, 2.68. A second prospect is located just north of State Road 609, 0.9 mile east of Rangeley, and 0.5 mile west of Fieldale. Physical test data for this rock are: Los Angeles loss (Grade A), 64.8; absor[illegible]; and specific gravity, 2.60. Another prospect is 0.1 mile east of State Road 876, and 0.25 mile southeast of the junction of State Road 876 with U. S. Highway 58. Physical test data are as follows: Los Angeles loss (Grade A), 37.7; absorption, 0.38; and specific gravity, 2.78.

The Leatherwood granite, Rich Acres Norite, granite gneiss, and the large diabase dike south of Fieldale would probably make adequate raw material for crushed stone. Two samples of the Leatherwood granite have been tested as a potential source for coarse aggregate (Virginia Dept. Highways, 1954, p. 54). One sample was from a prospect located on the east flank of a north-south ridge, 0.6 mile west-southwest of the junction of State Highway 108 and State Road 882, about 3 miles north of Martinsville. Physical test data for rock from this prospect are: Los Angeles loss (Grade A), 40.2; absorption, 0.75; and specific gravity, 2.99. The other sample was taken from an abandoned quarry (Plate 1, No. 3) just north of U. S. Highway 58, about 1.5 miles southwest of its intersection with State Road 687 at Horse Pasture. Physical test data are: Los Angeles loss (Grade A), 60.5; absorption, 0.75; and specific gravity, 2.64.

Although no production of building stone has been reported from rocks within the Martinsville West quadrangle, diabase, Rich Acres Norite, biotite gneiss, and the Leatherwood granite would make attractive ornamental stone. The chatoyancy of the feldspars in the Rich Acres Norite should make it an attractive polished stone for decorative purposes.

PEGMATITE MINERALS

The pegmatites in the Ridgeway area, located about 2.5 miles south of the quadrangle, are well known as sources for mica (Griffitts and others, 1953; Brown, 1962). Pegmatites in the area mapped are similar to these, and a small amount of sheet mica has been produced from them as evidenced by several mica prospect pits on the ridge south of Fieldale (Plate 1, Nos. 6-8). Most of the pegmatites are too small to be profitably exploited for mica, although a few of the larger ones might have some potential. Feldspar that occurs in pegmatite dikes in the area is a potential economic mineral. Potassic feldspar is present in many of the larger pegmatite bodies; one such potential deposit of feldspar is located in the southeast corner of the quadrangle (Plate 1, R-3334).

Brown (1945) reported an occurrence of beryl from a pegmatite dike located west of Grassy Creek, 0.5 mile north of U. S. Highway 58 and about 2.5 miles west of the intersection of U. S. Highways 58 and 220. He stated that the beryl is present as small crystals up to 7 inches in length. The pegmatite in question was examined by the writers but no beryl was found.

Kaolinite was found in the weathered zone of some of the larger pegmatite dikes in the northeast corner of the quadrangle (Plate 1). Most of these pegmatites are probably too small for sustained production and would be profitable only if several were mined in the same area. A small amount of kaolin was mined from an 80-foot-thick deposit occurring in the weathered zone of a pegmatite dike near Oak Level, slightly north of the quadrangle boundary (Watson, 1907, p. 163).

MAGNETITE AND EMERY

Several prospect pits and magnetite locations have been reported near Martinsville (Nitze, 1892). Two of these were found during the present investigation (Plate 1, Nos. 4, 5); one prospect (Plate 1, No. 4) consists of an open cut and several collapsed shafts. The magnetite is primarily associated with the sillimanite-mica schist, which has an average of 6.7 percent opaque minerals, most of which are magnetite. Another occurrence of magnetite within the outcrop area of the sillimanite-mica schist is along the crest of the ridge northwest of Jordan Creek 1.25 miles southwest of Fieldale. No prospect pits were found on this ridge, but individual magnetite crystals and magnetite-rich float are present along the crest and west flank of this ridge. Mertie (1956, p. 1692-1693) mentioned a magnetite location just south of the quadrangle. He regarded it as an ancient placer deposit and stated that it contained 69 percent magnetite, 15 percent ilmenite, 9 percent monazite, 3 percent zircon, 2 percent corundum, and 2 percent quartz. A collecting location for magnetite, with associated monazite, south of Fieldale has been reported (Dietrich, 1955, p. 15).

An occurrence of magnetite in association with corundum and spinel is located in the extreme southeastern corner of the quadrangle. One sample (R-3333) of this material contains 33.5 percent corundum, 30.5 percent magnetite, 29.0 percent spinel, and 7.9 percent chlorite. This composition is similar to that reported by Watson (1923) from emery deposits in Pittsylvania County; these deposits are located about 30 miles to the east and occur in similar lithologic units.

SILLIMANITE

Sillimanite occurs in the sillimanite-mica schist and in a few samples of biotite gneiss. The sillimanite in these rocks averages about 2.5 percent, but it is generally too disseminated to be of economic value. A hand specimen (R-3406) collected from the top of the hill 0.3 mile due east of Payne contains 25 percent sillimanite that occurs as lath-shaped bundles of needle-like crystals. Sericite is associated with, and has been formed from alteration of, sillimanite. Fine grinding would be necessary to separate sillimanite from sericite in these rocks, and the recovery of sillimanite would probably be rather low (Espenshade and Potter, 1960, p. 33).

MISCELLANEOUS MATERIALS

Although monazite was not recognized during this investigation, a belt of monazite-bearing rocks has been traced through the northern portion of the quadrangle (Mertie, 1953, Plate 1). The metasedimentary rocks in the area, referred to as Wissahickon schist, were thought to be the source of the monazite (Mertie, 1953, p. 24). Dietrich (1955, p. 15) described an occurrence of high-thorium monazite, associated with magnetite, in some old prospect pits south of Fieldale.

Tremolite-talc schist in the west-central portion of the quadrangle (Plate 1) might be suitable for the production of soapstone. It has been reported that soapstone was quarried from a locality near "Spencer's Store" and used locally for foundations and other purposes (Watson, 1907, p. 293). A definite location for this deposit was not given, but it would probably lie just west of the quadrangle boundary. The tremolite-talc schist body located 0.5 mile west of Stanleytown, just north of State Highway 57, it cut by several narrow quartz veins and pegmatite dikes, and 6- to 10-inch-thick bands of vermiculite occur at the contacts between tremolite-talc schist and the pegmatites. Concentrations of vermiculite have also been noted in association with amphibolite and tremolite-talc schist southwest of Rangeley, especially in the vicinity of Mount Bethel Church. Some of the larger quartz veins within the quadrangle (Plate 1) are of sufficient size and purity to warrant consideration as potential sources of quartz products.

Light- to medium-gray alluvial clay underlies much of the alluvium that is present along most of the rivers and streams in the area. This clay is generally covered by several inches to several feet of sand or sand and gravel. White clays in the alluvial terrace deposits might also be of economic interest for use in the production of light-burning brick.

Several minerals that are potentially suitable for use as gem stones occur within the quadrangle. Rose quartz and somewhat amethystine quartz were found in a series of pegmatite dikes cutting sillimanite-mica schist and biotite gneiss 1.5 miles north-northeast of the intersection of U. S. Highway 58 and State Road 687 at Horse Pasture. Blue quartz is present throughout much of the biotite gneiss, and generally occurs as small veinlets. Gem-quality garnet has been found in the Wilson Quarries, Plant No. 1 (Plate 1, No. 9) north of Horse Pasture (Mr. A. C. Wilson, personal communication).

AEROMAGNETIC SURVEY

Part of a recent aeromagnetic survey (Virginia Division of Mineral Resources, 1966) covers slightly more than one-half the area of the Martinsville West quadrangle. Figure 14 is a composite map showing

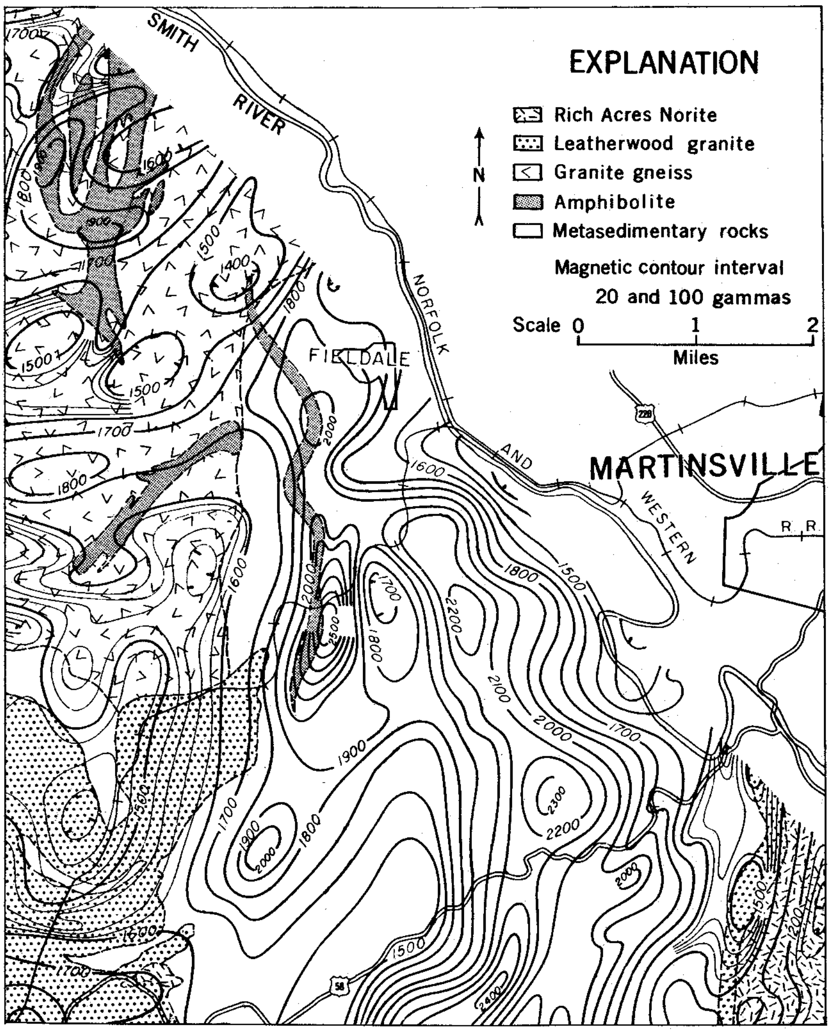

Figure 14. Aeromagnetic contours superimposed on generalized geologic map of the Martinsville West quadrangle.

geologic units and aeromagnetic contours. Rock units of minor areal extent such as diabase, ultramafic rocks, alluvial material, and pegmatites were omitted from this map. The structural trend and outcrop pattern of the metasedimentary rocks, including sillimanite-mica schist, biotite gneiss, and quartzite (Plate 1), are generally marked by linear aeromagnetic highs. The outcrop belt of the amphibolite is also characterized by slightly higher values of aeromagnetic intensity. Outcrop belts of the granite gneiss, Leatherwood granite, and Rich Acres Norite generally underlie areas of low magnetic intensity; however, the main mass of the Rich Acres Norite lies north of the area covered by this survey.

REFERENCES

Anderson, E. M., 1942, The dynamics of faulting and dyke formation, with applications to Britain: Edinburgh, Oliver and Boyd, 206 p.

Billings, M. P., 1954, Structural geology: Englewood Cliffs, N. J., Prentice-Hall, Inc., 514 p.

Brown, W. R., 1945, Some recent beryl finds in Virginia: Rocks and Minerals, vol. 20, no. 6, p. 264-265.

____________ 1962, Mica and feldspar deposits of Virginia: Virginia Division of Mineral Resources Mineral Resources Rept. 3, 195 p.

Cameron, E. N., and others, 1949, Internal structure of granitic pegmatites: Urbana, Ill., Econ. Geology Publ. Co., Mon. 2, 115 p.

Cazeau, C. J., 1963, Geology and structure of the Pendleton-LaFrance area, northwestern South Carolina: South Carolina Div. Geology, Geologic Notes, vol. 7, no. 3, 4, p. 15-18.

Dietrich, R. V., 1955, Additions to Virginia mineral localities: Virginia Poly. Inst., Eng. Expt. Sta. Ser. no. 105, 31 p.

Espenshade, G. H., and Potter, D. B., 1960, Kyanite, sillimanite, and andalusite deposits of the southeastern states: U. S. Geol. Survey Prof. Paper 336, 121 p.

Fenneman, N. M., 1938, Physiography of Eastern United States: New York, McGraw-Hill Book Co., Inc., 714 p.

Gooch, E. O., Wood, R. S., and Parrott, W. T., 1960, Sources of aggregate used in Virginia highway construction: Virginia Division of Mineral Resources Mineral Resources Rept. 1, 65 p.

Griffitts, W. R., Jahns, R. H., and Lemke, R. W., 1953, Mica deposits of the southeastern Piedmont, pt. 3, Ridgeway-Sandy Ridge district, Virginia and North Carolina: U. S. Geol. Survey Prof. Paper 248-C, p. 140-170.

Griffitts, W. R., and Overstreet, W. C., 1952, Granitic rocks of the western Carolina Piedmont: Am. Jour. Sci., vol. 250, no. 11, p. 777-789.

Imbrie, John, 1956, Biometrical methods in the study of invertebrate fossils: Am. Mus. Nat. Hist. Bull., vol. 108, art. 2, p. 211-252.

Jonas, A. I., 1932, Geology of the kyanite belt of Virginia, *in* Kyanite in Virginia: Virginia Geol. Survey Bull. 38, p. 1-38.

Kermack, K. A., and Haldane, J. B. S., 1950, Organic correlation and allometry: Biometricka, vol. 37, p. 30-41.

King, P. B., 1955, A geologic section across the southern Appalachians —an outline of the geology of the segment in Tennessee, North Carolina, and South Carolina, *in* Russell, R. J., ed., Guides to southeastern geology: Geol. Soc. America Guidebook, p. 332-373.

Larsen, L. H., and Poldervaart, Arie, 1957, Measurement and distribution of zircons in some granitic rocks of magmatic origin: Mineralogical Magazine, London, vol. 31, no. 238, p. 544-564.

Mertie, J. B., Jr., 1953, Monazite deposits of the southeastern Atlantic states: U. S. Geol. Survey Circ. 237, 31 p.

———— 1956, Ancient monazite placer (abs): Geol. Soc. America Bull., vol. 66, no. 12, pt. 2, p. 1692-1693.

Miyashiro, Akiho, 1961, Evolution of metamorphic belts: Jour. Petrology, vol. 2, p. 277-311.

Nitze, H. B. C., 1892, Notes on some of the magnetites of southwestern Virginia and of the contiguous territory of North Carolina: Am. Inst. Min. Eng. Trans., vol. 20, p. 174-188.

Overstreet, W. C., and Bell, Henry, III, 1965, The crystalline rocks of South Carolina: U. S. Geol. Survey Bull. 1183, 126 p.

Parrott, W. T., 1947, State operated quarry in Henry County: Virginia Dept. Highways Geol. Yearbook, vol. 1, rept. no. 28.

Pegau, A. A., 1932, Pegmatite deposits of Virginia: Virginia Geol. Survey Bull. 33, 123 p.

Richard, H. L., 1937, A petrographic study of some typical igneous and metamorphic rocks of the Virginia Piedmont and Blue Ridge: Unpublished M. S. thesis, Univ. Virginia, 79 p.

Sutherland, M. Y., Jr., 1935, A comparative study of the Virginia granites: Unpublished M. S. thesis, Univ. Virginia, 65 p.

Turner, F. J., 1948, Mineralogical and structural evolution of the metamorphic rocks: Geol. Soc. America Mem. 30, 342 p.

Virginia Department of Highways, 1954, Physical test results of the Virginia statewide aggregate survey: Virginia Dept. Highways, 68 p.

____________ 1963, Results of quality testing on commercially produced aggregates: Virginia Dept. Highways, 5 p.

Virginia Division of Mineral Resources, 1966, Magnetic and radiometric data, southwest Piedmont of Virginia: Virginia Division of Mineral Resources Inf. Circ. 12, 1 p.

Virginia Geological Survey, 1928, Geologic map of Virginia: Virginia Geol. Survey, scale 1:500,000.

Watson, T. L., 1907, Mineral resources of Virginia: Lynchburg, Va., J. P. Bell Co., 618 p.

____________ 1923, A contribution to the geology of the Virginia emery deposits: Econ. Geology, vol. 18, no. 1, p. 53-76.

Winkler, H. G. F., 1965, Petrogenesis of metamorphic rocks: New York, Springer-Verlag, 220 p.

GLOSSARY[1]

***a* direction**—The direction of tectonic transport, similar to the direction in which cards might slide over one another. Striae in a slickensided surface are parallel to *a*.

anatexis—The complete melting of crustal rocks to form granitic magma.

***b* direction**—That direction in the plane of movement at right angles to the direction of tectonic transport.

Boehm lamellae—Fine lamellae, lines, or bands marked by dusty inclusions, subparallel to the basal plane (001) of quartz, probably developed as a result of intracrystalline gliding on surfaces inclined at low angles to that plane.

boudinage—A structure in which beds set in a yielding martix are divided by cross-fractures into pillow-like segments.

deuteric alteration—Changes in an igneous rock produced during the later stages of, and as a direct consequence of, the consolidation of the magma.

feldspathization—Introduction of, or replacement by, feldpars.

foliation—The laminated structure resulting from segregation of different minerals into layers parallel to the schistosity.

left bank—The left side of a river as it would appear facing downstream.

lineation—The parallel orientation of structural features that are linear rather than planar.

metasedimentary rocks—Partly metamorphosed sedimentary rocks.

metasomatism—Replacement. Simultaneous solution and deposition by which a new mineral of partly or wholly differing chemical composition may grow in the body of an old mineral.

migmatite banding—Alternating layers of granite and country rock.

paragneiss—A gneiss derived from a sedimentary rock.

paraschist—A schist derived from a sedimentary rock.

poikilitic—A textural term denoting a condition in which small granular crystals are irregularly scattered without common orientation in a larger crystal of another mineral.

porphyroblasts—Large crystals in a finer grained matrix produced by thermodynamic metamorphism.

ptygmatic folds—Folds in beds that offer so little resistance to deformation that they assume any shape impressed upon them.

refractory masses—Rock masses that resist change due to heat and chemical actions.

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[1] Definitions taken or adapted from *Glossary of Geology and Related Sciences*, published by The American Geological Institute, 1962.

relict—Relating to minerals that represent an earlier stage or assemblage, which have persisted in spite of processes tending to destroy them.

retrograde metamorphism—The mineralogical adjustment of relatively high-grade metamorphic rocks to temperatures lower than those of their initial metamorphism.

rodding—A structural feature consisting of small, parallel, cylindrical rods that form when folded sheets become thinner on the limbs of folds and thicker at the axes.

saprolite—Thoroughly decomposed, earthy, but untransported rock.

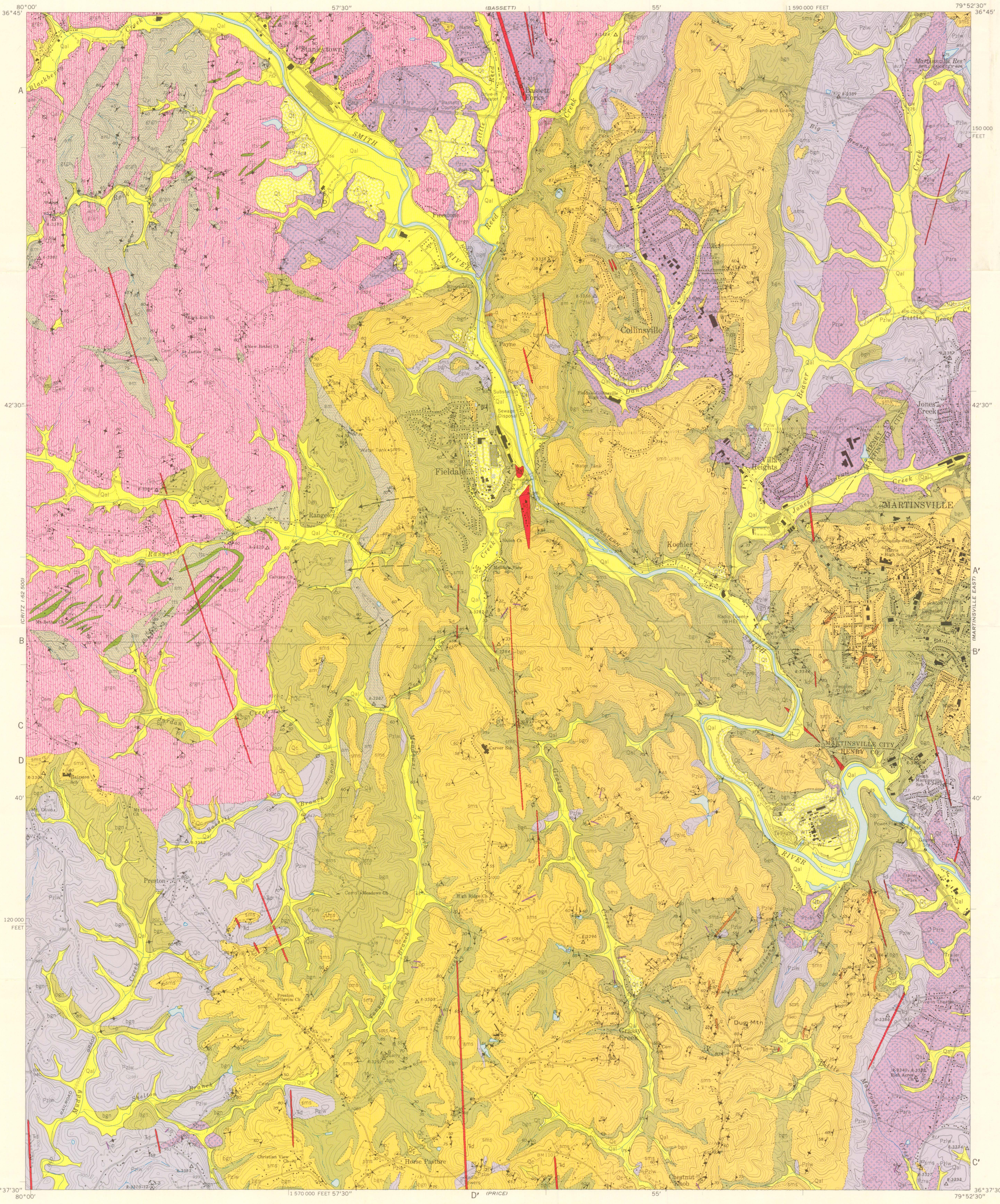
schiller—A bronze-like luster or irridescence.

skialith—Cloudy relics of ghostlike remnants of pre-existing rocks found in bodies of granitic rock which have been produced by granitization.

INDEX

COMMONWEALTH OF VIRGINIA
DEPARTMENT OF CONSERVATION AND ECONOMIC DEVELOPMENT
DIVISION OF MINERAL RESOURCES
James L. Calver
Commissioner of Mineral Resources and State Geologist

REPORT OF INVESTIGATIONS 16
PLATE 1



EXPLANATION

CENOZOIC — QUATERNARY

- Qal — Alluvium
- Qt — Terrace deposits
- Qc — Colluvium

MESOZOIC — TRIASSIC

- ₮d — Diabase dikes

PALEOZOIC

- p — Pegmatite dikes
- Pzra — Rich Acres Norite
- Pzlw — Leatherwood granite

PRECAMBRIAN (?)

- tts — Tremolite-talc schist
- grgn — Granite gneiss
- am — Amphibolite
- bgn — Biotite gneiss
- q — Quartzite
- sms — Sillimanite-mica schist

CONTACTS

- exposed
- approximate
- covered or inferred

FOLDS

- Anticline - trace of axial plane and direction of plunge of axis, approximate
- Syncline - trace of axial plane and direction of plunge of axis, approximate
- Overturned anticline - trace of axial plane
- 18 Direction and plunge of minor anticline
- 6 Direction and plunge of minor syncline
- 24 Direction and plunge of minor overturned anticline

FAULTS

U / D exposed U - upthrown side, D - downthrown side

SHEAR ZONE

FOLIATION

- 87 Strike and dip of foliation
- Strike of vertical foliation
- 42 Strike and dip of compositional bands

LINEATIONS - used in combination with foliation symbols

- 27 Bearing and plunge of mineral lineation
- Bearing of mineral lineation in plane of foliation
- 21 Bearing of horizontal lineation
- 16 Bearing and plunge of lineation for rodding, boudinage and crinkle folds
- Bearing of lineation in plane of foliation

SAMPLE LOCATIONS

R-3402 Locations of samples representative of different lithologies mapped

QUARRIES, MINES, AND PROSPECTS

ACTIVE QUARRY

1. Martinsville Stone Corporation: biotite gneiss
9. Wilson quarries, Plant No. 1: biotite gneiss

ABANDONED QUARRY OR MINE

2. Biotite gneiss
3. Leatherwood granite
4. Magnetite

PROSPECT

5. Magnetite
6. Mica
7. Mica
8. Mica

STRIKE OF QUARTZ VEIN

Base from U.S. Geological Survey, 1963
Martinsville West Quadrangle 7½-minute Series

GEOLOGIC MAP OF THE MARTINSVILLE WEST QUADRANGLE, VIRGINIA

Geology by James F. Conley and E. Clayton Toewe

MN 3½°

SCALE 1:24 000

1 ½ 0 1 MILE

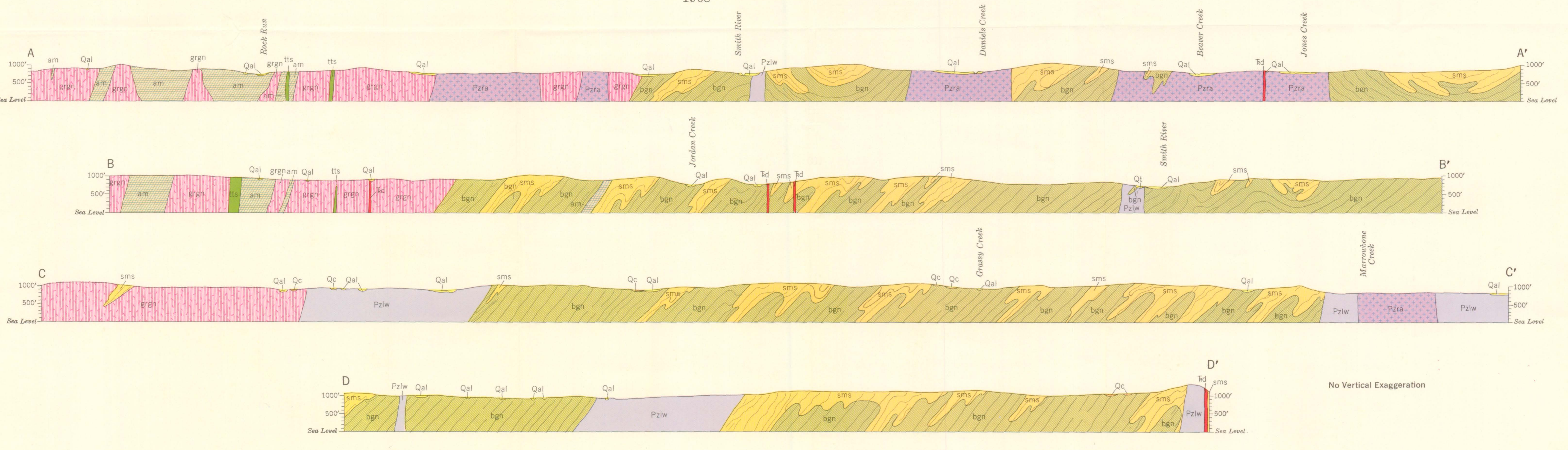
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

CONTOUR INTERVAL 20 FEET
DATUM IS MEAN SEA LEVEL

1968

VIRGINIA
QUADRANGLE LOCATION



No Vertical Exaggeration