COMMONWEALTH OF VIRGINIA
DEPARTMENT OF CONSERVATION
AND ECONOMIC DEVELOPMENT

DIVISION OF MINERAL RESOURCES

GEOLOGY OF THE SNOW CREEK, MARTINSVILLE EAST, PRICE, AND SPRAY QUADRANGLES, VIRGINIA

JAMES F. CONLEY AND
WILLIAM S. HENIKA

REPORT OF INVESTIGATIONS 33

VIRGINIA DIVISION OF MINERAL RESOURCES
James L. Calver
Commissioner of Mineral Resources and State Geologist

CHARLOTTESVILLE, VIRGINIA
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RICHMOND
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Conley, J. F., and Henika, W. S., 1973, Geology of the Snow Creek, Martinsville East, Price, and Spray quadrangles, Virginia: Virginia Division of Mineral Resources Rept. Inv. 33, 71 p.

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CONTENTS

PAGE

ILLUSTRATIONS

PLATE PAGE

FIGURE

TABLE

GEOLOGY OF THE SNOW CREEK, MARTINSVILLE EAST, PRICE, AND SPRAY QUADRANGLES, VIRGINIA

By

JAMES F. CONLEY AND WILLIAM S. HENIKA

ABSTRACT

The Snow Creek, Martinsville East, Price, and Spray quadrangles are located just north of the Virginia-North Carolina boundary in the inner Piedmont physiographic province of southwestern Virginia and comprise approximately 202 square miles in Henry and Franklin counties. The quadrangles contain parts of three regional structures: the Blue Ridge anticlinorium, the Smith River allochthon, and the Sauratown Mountains anticlinorium.

The rocks of the Blue Ridge anticlinorium are contained in the southeastern limb of the Cooper Creek anticline. This fold is composed of a core of Precambrian Moneta gneiss, which is unconformably overlain by the Lynchburg Formation.

The Smith River allochthon is a complexly folded, shallow synformal structure that is bounded on the northwest by the southeastward-dipping Bowens Creek fault and on the southeast by the northwestward-dipping Ridgeway fault. It is composed of Precambrian igneous intrusives, and metasedimentary rocks that have been regionally metamorphosed at staurolite and sillimanite grade. These rocks are divided into the Bassett formation, which is composed of a leucocratic biotite gneiss overlain by amphibolite; the Fork Mountain formation, which is composed of high-alumina schists; and intruded by the Leatherwood Granite and Rich Acres formation, which form a large mass of intrusive igneous rock dated at 1020 million years old. Prior to, or during, the intrusion by the igneous rocks, the regional staurolite and sillimanite in the Fork Mountain formation were partially to totally altered to pseudomorphous sericite. As the igneous rocks were emplaced, a metamorphic aureole developed in the adjacent country rock. The Fork Mountain formation was the unit most affected by the metamorphism and in the proximity of the igneous rocks, garnetiferous biotite gneiss was formed. Sillimanite and kyanite formed in the formation in or near the igneous mass and chloritoid in the schist further away. Where the Bassett is in contact with the igneous rocks, zones of partial melting developed.

The northwestern limb of the Sauratown Mountains anticlinorium is exposed across the southeastern part of the area. The structure contains older Precambrian granitic augen gneiss that is overlain by younger Precambrian metasedimentary gneiss and mica schist, which have dips to the northwest off its northwestern limb. The metasedimentary rocks are at kyanite grade and contain complex polyphase folds that generally do not penetrate the underlying granitic augen gneiss.

Mica has been mined on Fork Mountain and along the Ridgeway fault. Stone has been produced from the Leatherwood Granite. The garnetiferous-biotite gneiss of the Fork Mountain and the leucocratic biotite gneiss of the Bassett formation have been quarried in surrounding areas. Other rocks and minerals of economic interest are talc and soapstone, pegmatite minerals, mica schist, magnetite, emery, sillimanite, and kyanite.

INTRODUCTION

The Snow Creek, Martinsville East, Price, and Spray quadrangles are located in the inner Piedmont physiographic province of southwestern Virginia and northwestern North Carolina (Figure 1). The mapped area comprises approximately 202 square miles in Henry and Franklin counties, Virginia. Martinsville is the major city. Topography of the inner Piedmont consists of subdued ridges and wide valleys filled with alluvium; major features in the quadrangles include

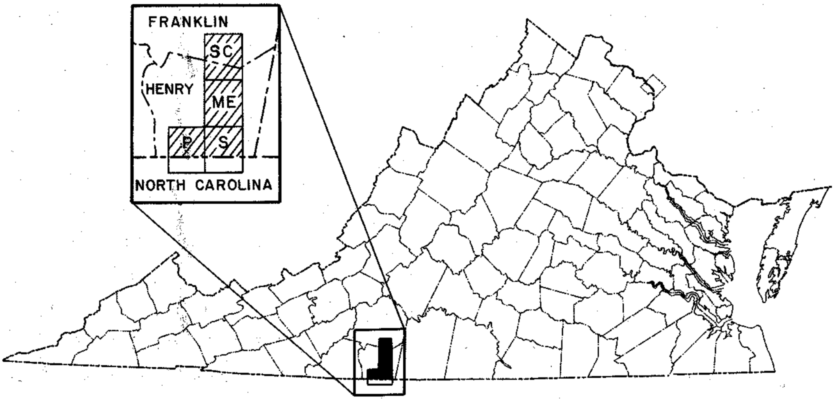

Figure 1. Index map showing location of area studied (SC, Snow Creek quadrangle; ME, Martinsville East quadrangle; P, Price quadrangle; and S, Spray quadrangle).

Fork Mountain and Turkeycock Mountain. Smaller monadnocks are Nantes Mountain, Chestnut Knob, and Holt Mountain.

Previous geologic mapping in the region was a reconnaissance study for the geologic map of Virginia (Virginia Geological Survey, 1928); reconnaissance surveys for ground-water reports of the Greensboro area (Mundorf, 1948) and of Pittsylvania and Halifax counties (LeGrand, 1960); and detailed mapping of the Martinsville West (Conley and Toewe, 1968), Philpott Reservoir (Conley and Henika, 1970), and Bassett (Henika, 1971) 7.5-minute quadrangles. The Sauratown Mountains anticlinorium was mapped by Butler and Dunn (1968). Reconnaissance mapping in the Winston-Salem 1 x 2 degree quadrangle (1:250,000-scale) has nearly been completed by the U. S. Geological Survey (Rankin, 1971).

Mapping was done from the summer of 1969 through the spring of 1971, mostly during the summer months when vegetative cover and dense, second-growth timber made it difficult. A deep saprolite and soil cover greatly limits the amount of exposure throughout the area.

John Algor assisted in the mapping of the Martinsville East, Price, and Spray quadrangles. He contributed to the study of the petrography and plotted the discordant zircon age dates obtained from the Martinsville West quadrangle on a concordia diagram. Ronald D. Kreisa helped in the petrographic study of rocks of the area and prepared a number of illustrations for the report. Paul C. Ragland spent the summer of 1970 mapping in the Snow Creek quadrangle and collected rock samples from which about 60 were selected for chemical analyses. Dr. James L. Calver read the manuscript and made suggestions on how the report could be improved. Bruce Taylor served as a field assistant for three summers.

Numbers preceded by "R" (R-4697) correspond to sample localities shown on Plates 1, 2, and 3; samples are on file in the Virginia Division of Mineral Resources repository where they are available for examination.

STRATIGRAPHY

PRECAMBRIAN ROCKS

The northern part of the mapped area contains older Precambrian Moneta gneiss unconformably overlain by the younger Precambrian Lynchburg Formation (Table 1). The central part is composed of older Precambrian paragneisses and paraschists that have been regionally metamorphosed to staurolite and sillimanite grade and retrograded

Table 1.—Geologic formations in the Snow Creek, Martinsville East, Price, and Spray quadrangles.

Age	Blue Ridge anticlinorium	Sauratown Mtns. anticlinorium	Smith River allochthon
Quaternary	Alluvium	Alluvium	Alluvium
	Alluvial-terrace deposits	Alluvial-terrace deposits Colluvium	Alluvial-terrace deposits Colluvium
Triassic		Diabase dikes	Diabase dikes
Precambrian(?)		Alaskite, pegmatite, and leuco-quartz diorite Altered metapyroxenite and talc schist	Alaskite, pegmatite, and leuco-quartz diorite Talc-tremolite schist, in part metapyroxenite
Precambrian	Lynchburg Formation (820 million years old)	Gneiss and mica schist muscovite and muscovite-biotite gneiss garnet-mica schist	Rich Acres formation (younger part) norite-diorite Leatherwood Granite (1020 million years old) Rich Acres formation (older part) gabbro Fork Mountain formation biotite gneiss mica schist Bassett formation amphibolite leucocratic biotite gneiss
	Major unconformity	Major unconformity	
	Moneta gneiss (1000 million years old)	Granitic augen gneiss (1192 million years old)	

to chlorite grade. These metasedimentary rocks have been intruded by a large semi-concordant igneous body. It consists of the Leatherwood Granite and Rich Acres formation which is surrounded on the surface by a pronounced metamorphic aureole.

The southern part of the area contains a basement core of older Precambrian granitic augen gneiss overlain by younger Precambrian metasedimentary rocks. The metasedimentary rocks consist of a lower mica schist and an upper gneiss and are the northern extension of units referred to as rocks of "Brevard zone affinities" by Butler and Dunn (1968, p. 39), who traced them southwestward to the Brevard zone and westward around the nose of the James River synclinorium (which in the present report contains the Smith River allochthon, Figure 24). Their northern extention on the western limb of the synclinorium lies along the strike projection of the Lynchburg Formation as shown on the geologic map of Virginia (Virginia Division of Mineral Resources, 1963).

MONETA GNEISS

The Moneta gneiss is exposed in the extreme northwestern part of the Snow Creek quadrangle, northwest of the Bowens Creek fault (Plate 1). It is the basement on which the Lynchburg Formation was deposited (Conley and Henika, 1970, p. 10 and 36; Henika, 1971, p. 3). Brown (1958, p. 9 and 12) thought the Moneta had been injected by migmatite from the Marshall Gneiss and called this mixed rock the "Reusens migmatite facies of the Moneta gneiss". Bloomer (1950, p. 764) noted an older gneiss that is locally migmatitic and grades by increase of feldspar into the basement complex. He further indicated that skialiths of metasediments occur in rocks of the complex (Bloomer, 1950, p. 760). Brown (1970, p. 337) noted that the igneous rocks, which intrude the Moneta, are about one billion years old, indicating the age for the Moneta is even older (Table 1).

The Moneta consists of three lithologies: mica gneiss, plagioclase-quartz gneiss, and amphibolite. The predominant lithology is foliated mica gneiss with subordinate interlayers of light-gray, plagioclase-quartz gneiss and amphibolite. The gneissic part of the Moneta is poorly exposed in the Snow Creek quadrangle and is generally mantled by deep saprolite. The saprolite is mica-rich and has a characteristic tan color. The alternating mica-rich and plagioclase-quartz-rich bands can be distinguished in saprolite by alternating mica-rich and clay-quartz-rich zones. Fresh to slightly weathered exposures of Moneta occur along Big Chestnut Creek in the Glade Hill quadrangle north of the Snow Creek quadrangle; samples of the mica and plagioclase-quartz gneisses were collected near the intersection of State Road 619 and Big Chestnut Creek (R-4696 and R-4697).

The mica gneiss (R-4697, Figure 2) is composed predominantly of muscovite accompanied by equal amounts of plagioclase, quartz, and biotite and by trace amounts of epidote, magnetite, and zircon. The rock has a well-developed schistosity produced by subparallel 0.1-1.5 mm mica (muscovite and biotite) porphyroblasts, some of which grow across foliation. It is completely recrystallized to a granoblastic texture with polygonatized quartz grains as seen in thin sections. It contains plagioclase as 2-3 mm flattened grains and as porphyroblasts that have numerous quartz inclusions, and cut across foliation.

The interlayered plagioclase-quartz gneiss (R-4696) is light gray, equigranular, fine grained (median grain size, 1 mm) and has a salt and pepper appearance from quartz-feldspar and biotite. Poorly developed foliation is produced by oriented mica (predominantly biotite)

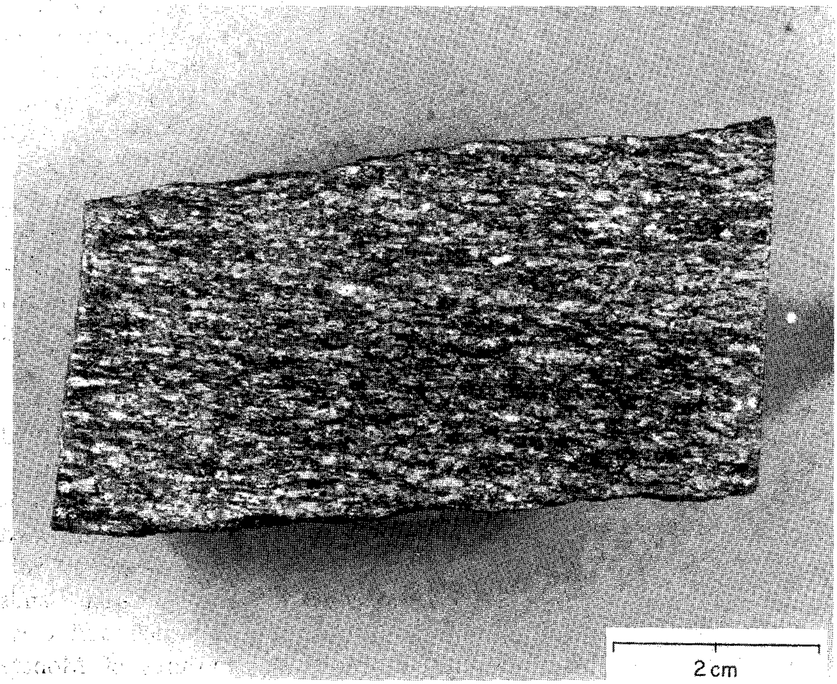

Figure 2. Sawed slab of Moneta gneiss (R-4697) northeast side of State Road 619 at Big Chestnut Creek, Glade Hill quadrangle.

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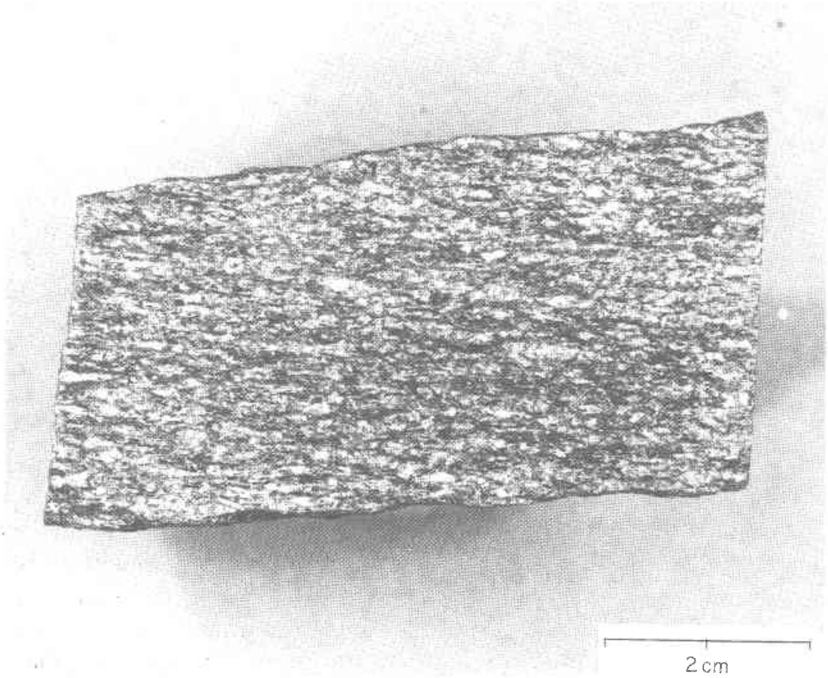


Figure 2. Sawed slab of Moneta gneiss (R-4697) northeast side of State Road 619 at Big Chestnut Creek, Glade Hill quadrangle.

evenly dispersed throughout the rock. In thin section the gneiss is composed of (in order of abundance) quartz, plagioclase (oligoclase-andesine), biotite, muscovite, and epidote.

Amphibolite, ranging to amphibole gneiss and schist, occurs as thin interbeds in the mica gneiss; it is only wide enough to be shown on the map along the northwestern edge of the Bowens Creek fault (Plate 1). This amphibolite has been traced in a southeasterly direction for over 11 miles around the eastern limb and nose of the Cooper Creek anticline (Plate 4). There is an interfingering relationship with the mica gneiss along the northwestern contact and the amphibolite contains lensoidal interlayers of mica gneiss. Good exposures of the unit occur along U. S. Highway 220 and State Road 718. Thin rusty-brown saprolite and thin, clay-rich, dark reddish-brown to maroon soils are developed on the rock. On weathering the rock breaks down into parallel, wafer-thin (0.5-2 mm thick) fragments. Outcrops along State Road 718 contain numerous minor internal open and overturned folds. These are in marked contrast to the mica gneiss which generally shows only planar foliation. Minerals composing the rock are amphibole (probably hornblende), quartz, clinozoisite, plagioclase, opaque minerals, and chlorite.

GRANITIC AUGEN GNEISS

The granitic augen gneiss in the core of the Sauratown Mountains anticlinorium (Plates 3, 4) is exposed in stream valleys and rock cliffs along Smith River. Outcrops along Stuart Creek are considered typical of the unit. The rocks are here tentatively correlated with the granitic augen gneiss (quarry at Pilot Mountain, North Carolina) dated as 1192 million years old (Rankin, 1971, p. 343).

The unit includes granitic augen gneiss, granitic flaser gneiss, biotite schist, hornblende schist and gneiss, and leucocratic foliated granite. These lithologies occur interlayered with each other, but not all are present in every exposure. A brown micaceous saprolite has developed on the gneiss and is exposed in deep cuts along State Road 632, 0.4 mile north of the Virginia-North Carolina boundary.

The augen gneiss in Stuart Creek and along State Road 637 west of Stuart Creek (R-4640, Figure 3) is irregularly banded, medium gray, and generally coarse grained. It contains from 25 to 60 percent microcline and perthite augen up to 2.4 cm in diameter. Quartz, composing from 20 to 40 percent of the rock, has three distinct modes of occurrence: polygonal grains, 0.1-0.5 mm across; veins in fractured feldspar augen; and polycrystalline aggregates similar in size and shape

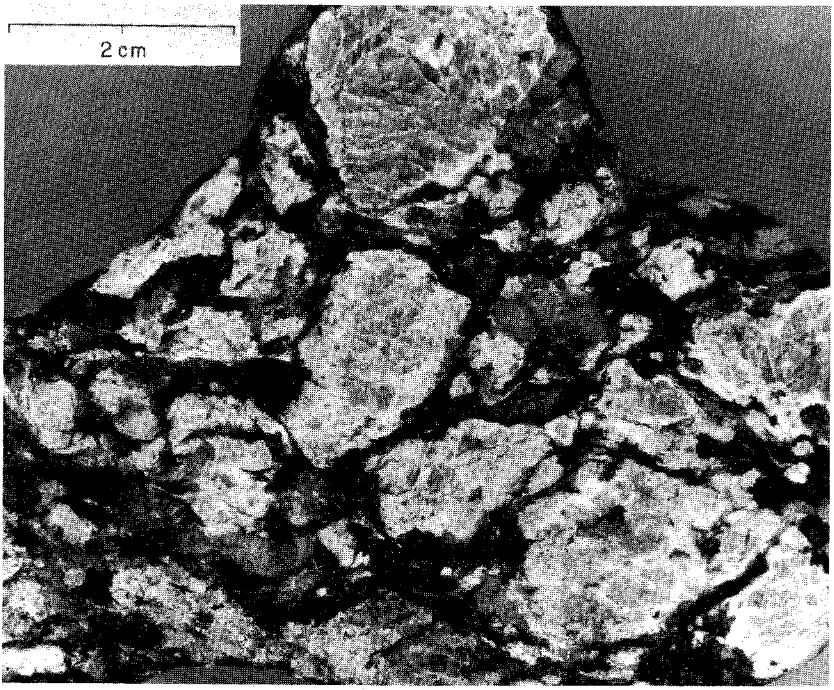
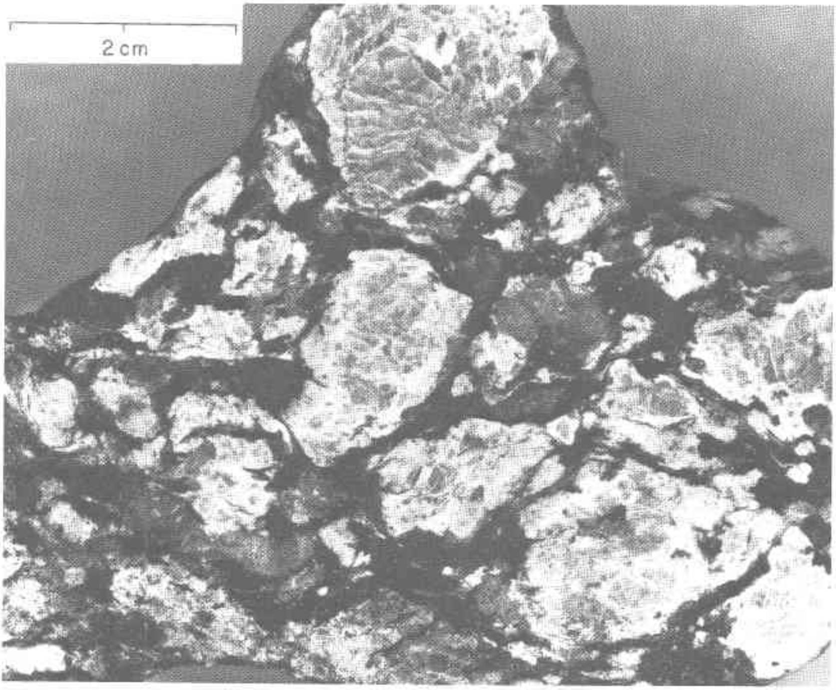


Figure 3. Sawed slab of granitic augen gneiss (R-4640) from southwest side of State Road 637, above Stuart Creek, Spray quadrangle.

to the feldspar augen. Approximately 15 percent of the rock is composed of contorted laths of reddish-brown biotite that is concentrated in segregation bands which wrap around the feldspar augen. Zircon, rutile needles, and opaque minerals occur as inclusions in biotite and in the interstices between the feldspar augen.

The flaser gneiss is exposed in the south-central part of the Spray quadrangle along Jones Branch from south of State Road 637 to the Virginia-North Carolina boundary, and at the southeastern corner of the intersection of State Road 622 and State Highway 87 (R-4641, Figure 4). The rock is medium to coarse grained, and has a striped appearance because of relatively thin (0.5-2 mm), black (predominantly biotite) and white (quartz-feldspar) layers. These are crenulated and offset by a secondary cleavage cutting the banding at a very acute angle. The white quartz-feldspar segregations are S-shaped lenticles normal to the foliation. A characteristic lineation is produced where the thicker lenticles intersect surfaces parallel to banding. Mineralogically, the flaser gneiss is similar to the augen gneiss. It contains about



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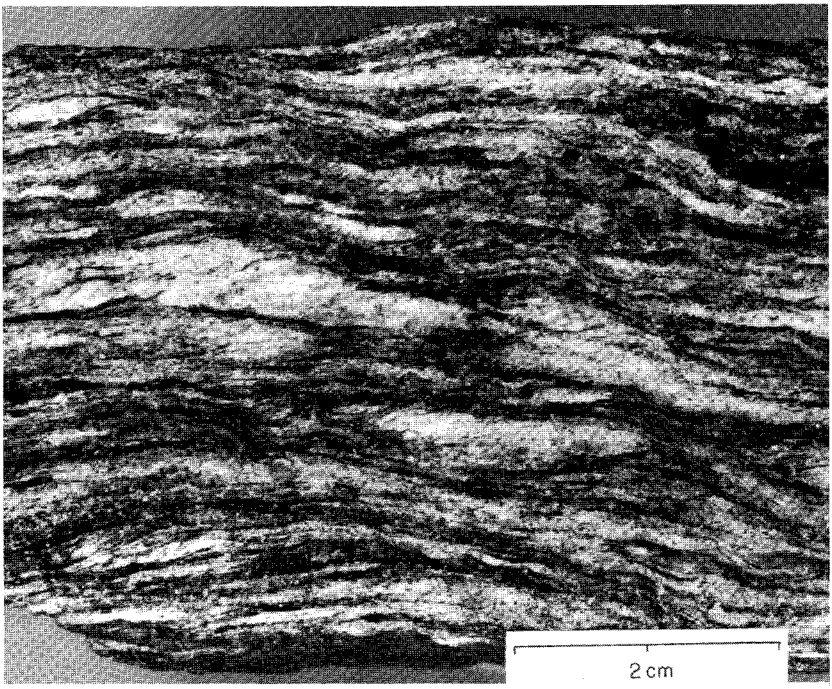
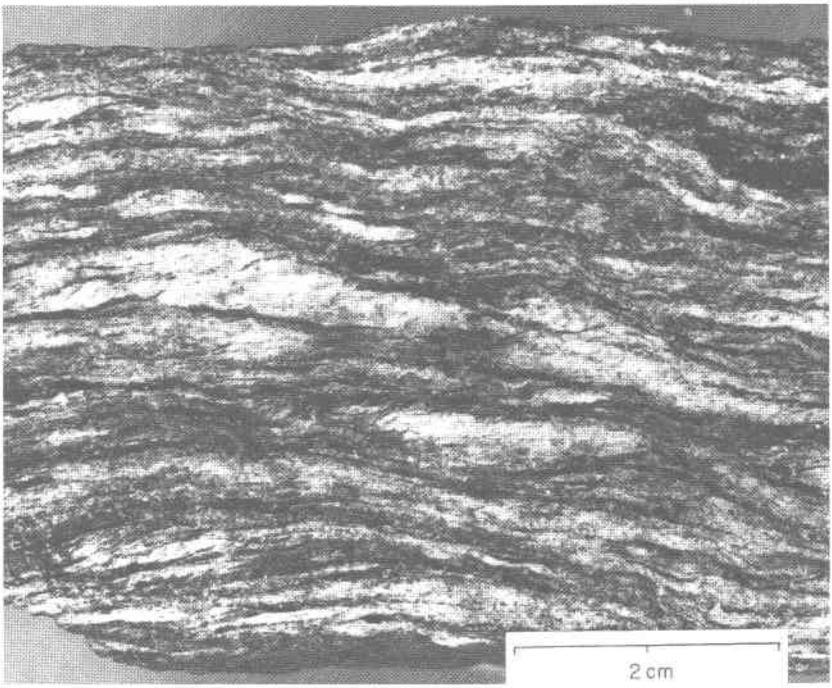


Figure 4. Sawed slab of granitic flaser gneiss (R-4641) at the intersection of State Road 622 and State Highway 87, Spray quadrangle.

40 percent quartz that occurs as strained, polygonal grains, 0.8 mm in length, intergrown with microcline, perthite, and plagioclase; about 25 percent potassic feldspar; and about 15 percent biotite. Muscovite porphyroblasts, oriented across the folia, make up 10 percent or less. Other minerals are plagioclase, garnet, zoned allanite-epidote, rutile, sphene, and opaques.

Biotite schist bands in the gneiss were noted only in saprolite, such as at the exposure along State Road 622 about 0.5 mile southwest of the intersection with State Highway 87. The schist bands are generally discordant to the compositional banding of the gneiss, having similar strikes, but more gentle dips. They have the appearance of anastomosing veins, cutting traceable layers in the gneiss.

Hornblende schist layers in the gneiss are dark colored, medium grained, and well foliated. The rock is composed of 40 percent elongate hornblende prisms up to 1 mm long, 35 percent granular plagioclase and quartz, and 20 percent subparallel and oriented biotite porphyroblasts about 0.8 mm across. Subparallel hornblende prisms produce a lineation on the foliation surfaces.



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BASSETT FORMATION

The Bassett formation consists of a leucocratic biotite gneiss that is overlain by an amphibolite unit. It is here informally named for exposures at the town of Bassett, Henry County, Virginia; its reference area is along Smith River between Firestone and North Bassett in the Martinsville West and Bassett 7.5-minute quadrangles (R-3321, R-3322, and R-3324). Exposures of the formation occur on both sides of the river, especially along State Highway 57 at Stanleytown and along State Highway Alternate 57 between Rock Run and Blackberry Creek (Martinsville West quadrangle). The formation is interpreted as the lowest unit at the surface in the Smith River allochthon, but its stratigraphic position in relation to the overlying rocks is uncertain because of complex folding. In the report area the Bassett occurs mainly between the two parallel ridges that form Fork Mountain in the Snow Creek quadrangle and to the southeast, in a wide band across the Snow Creek, Bassett, Martinsville West, and Price quadrangles (Plates 1, 3, 4).

Leucocratic Biotite Gneiss

The leucocratic biotite gneiss develops a reddish-brown saprolite and a quartz-rich, tan- to light reddish-brown soil. Areas underlain by the gneiss have a characteristic, subdued rolling topography and the rock is blanketed by a deep saprolite and thick soil; therefore, fresh exposures are rare.

The gneiss is generally equigranular, medium grained, and light to medium gray with biotite dispersed through a leucocratic groundmass. It is mostly segregation-banded with well-defined, alternating feldspar-rich and biotite-rich layers, but contains some massive layers. A much less common lithology, which developed near the contact with the Leatherwood and Rich Acres formations, consists of a plagioclase porphyroblast gneiss. At or near the contact with the igneous rocks, the gneiss is coarser grained, has a granitoid texture, and contains numerous migmatite bands and pegmatitic dikes and sills. In the northeastern part of the Snow Creek quadrangle, especially along State Road 619 south of Snow Creek Church, the gneiss contains interbeds of muscovite-biotite schist. Other lithologies include a quartz gneiss containing about 50 percent quartz and less than 10 percent plagioclase (R-4582, Plate 1) and an unusual epidote-pyroxene-quartz plagioclase gneiss (R-4629, Plate 1). The gneiss (R-4630, R-4631 and R-4830, Plate 1) is typically composed of 50 to 55 percent plagioclase (oligoclase-andesine), 15 to 30 percent quartz, 15 to 30 percent biotite, and varying small amounts of sphene, magnetite, microcline, muscovite, zircon, epidote overgrowths on allanite, and biotite. The rock has a granoblastic texture with polygonatized interlocking and sutured quartz grains, equidimensional and rare, large, zoned plagioclase porphyroblasts that are generally sheared.

Amphibolite

The amphibolite unit overlies the gneiss, although thin amphibolites occur as interbeds in the gneiss. The amphibolite is well exposed in the Snow Creek quadrangle along the Lester Lumber Company (private) road that extends southwest off State Road 657 between Camp Branch Church and Flat Rock Church (R-4129, R-4130, and R-4131, Plate 1). On weathering the amphibolite develops a thin ocherous rind and ultimately breaks down to shallow, clay-rich, red-brown, spongy saprolite and dark-red and dark reddish-brown clay soils. The rock is dark-greenish black and contains light and dark minerals. It generally is massive, but contains a foliation caused by strongly lineated hornblende and ptygmatically-folded leucocratic bands. In thin section it has nematoblastic schistosity and is composed of 40 to 70 percent hornblende, 15 to 35 percent plagioclase, and 2 to 15 percent quartz with lesser amounts of epidote, clinopyroxene, sphene, ilmenite, magnetite, and apatite. Chlorite, rutile, zircon, biotite, and garnet are present as traces in some samples.

The amphibolite northwest of Camp Branch, north of the Martinsville Reservoir, and on Blue Mountain (Snow Creek quadrangle) has been intruded by pyroxene gabbro (R-4632, Plate 1), which is probably part of the Rich Acres formation. This gabbro was not mapped as a separate unit because of poor exposures of the intermixed units and similarity of saprolites developed on the two units.

Pyroxene granofels occurs sporadically in the amphibolite, especially in areas containing epidotized zones. The granofels, generally as float, consists of anastomosing net veins some of which show pronounced boudin structures. It is light-grayish brown (R-4632, Plate 1) to black (R-4680, Plate 3), medium to fine grained, and has a nonfoliated granoblastic texture (R-4725, Figure 5).

The major minerals are clinopyroxene, plagioclase, grossular garnet, quartz, and epidote with lesser amounts of sphene, magnetite, ilmenite, biotite, zircon, apatite, and hornblende. Epidote occurs as kelyphitic rims on feldspar, and to a lesser extent on pyroxene when pyroxene is in contact with feldspar grains. Garnet generally fills the interstices between feldspars. The plagioclase and garnet are poikiloblastic and contain inclusions of quartz, pyroxene, and sphene.

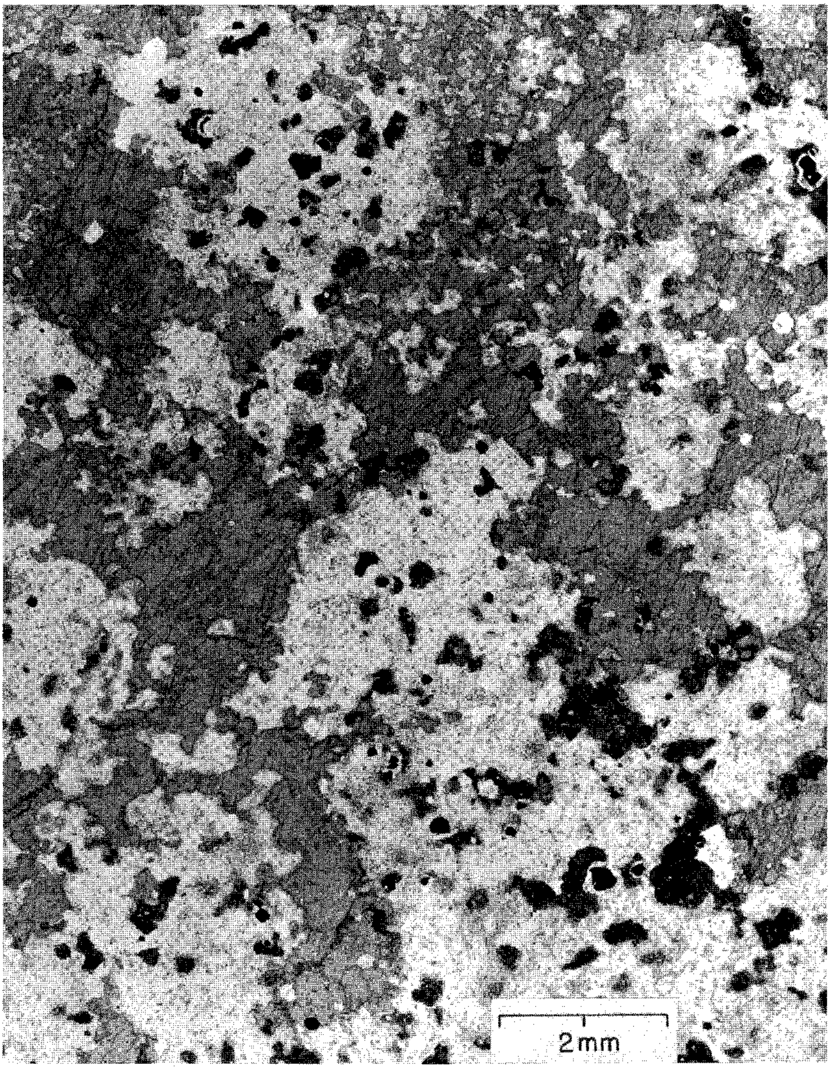

Figure 5. Photomicrograph of garnet-pyroxene granofels (R-4725), west of State Road 619 south of where it crosses Crab Creek, Snow Creek quadrangle; plane-polarized light.

FORK MOUNTAIN FORMATION

The Fork Mountain formation is here informally named for exposures on Fork Mountain in the northwestern part of the Snow Creek quadrangle, Franklin County (Plate 1). Its reference area is along the

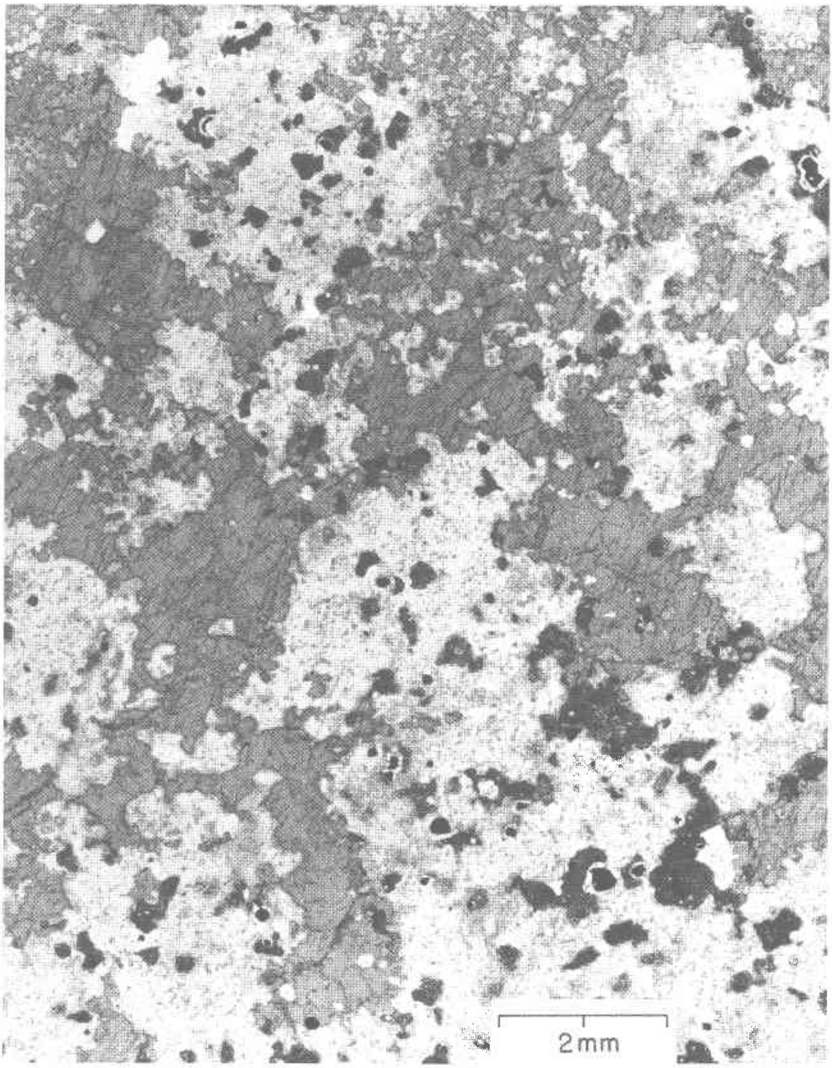

Figure 5. Photomicrograph of garnet-pyroxene granofels (R-4725), west of State Road 619 south of where it crosses Crab Creek, Snow Creek quadrangle; plane-polarized light.

FORK MOUNTAIN FORMATION

The Fork Mountain formation is here informally named for exposures on Fork Mountain in the northwestern part of the Snow Creek quadrangle, Franklin County (Plate 1). Its reference area is along the southeastern and northwestern forks of the mountain. The formation consists predominantly of mica schist and contains thin discontinuous lenses of quartzite and micaceous gneiss. It consists of mica hornfels and garnetiferous biotite gneiss near the contact with intrusive rocks of the Rich Acres formation and Leatherwood Granite.

Mica Schist

The mica schist underlies some of the highest topography in the area. Soils developed on this unit are thin, light-reddish brown, and contain a large percentage of quartz and chips of mica schist. Saprolites are grayish red or red to reddish brown, very micaceous, and generally contain ocherous weathered garnets. The rock consists of muscovite schist containing large relict staurolite and sillimanite. The boundary between staurolite- and sillimanite-bearing schist is a somewhat indefinite early regional metamorphic isogradic boundary.

The muscovite schist containing relict staurolite is well exposed in a vertical cliff (R-4634, Plate 1) along the crest of the northwestern fork of Fork Mountain southwest of Catsteps Trail. The rock contains cruciform-twinned porphyroblasts of staurolite as much as 3 cm long that have generally been altered to pseudomorphous masses of sericite (R-4726, Figure 6).

The relict sillimanite in the schist southeast of the regional isograd is generally altered to pseudomorphous bundles of sericite and in some places is only preserved as inclusions in garnet, magnetite, and to a lesser extent in quartz grains.

The Fork Mountain schist is light to medium gray, generally porphyroblastic, fine to medium grained and has some segregation banding. Porphyroblasts consisting of poikiloblastic garnet 1 mm-2 cm thick and muscovite from 2 to 8 mm occur in a sericite groundmass. The garnets show polyphase growth with cores containing sigmoidal trains of inclusions and euhedral overgrowths.

The rock contains from 25 to 60 percent sericite, 10 to 19 percent muscovite porphyroblasts, and 10 to 25 percent quartz. Although not present in all samples, chlorite can compose from 15 to 33 percent; chloritoid from 3 to 19 percent; garnet from 1 to 3 percent; ilmenite from 2 to 10 percent; and tourmaline, magnetite, and zircon in traces up to 2 percent.

One sample (R-4635, shown on Plate 1 as R-4636) from Grassy Fork on the northwest slope of Turkeycock Mountain probably contains the regional sillimanite-biotite assemblage that suggests that biotite

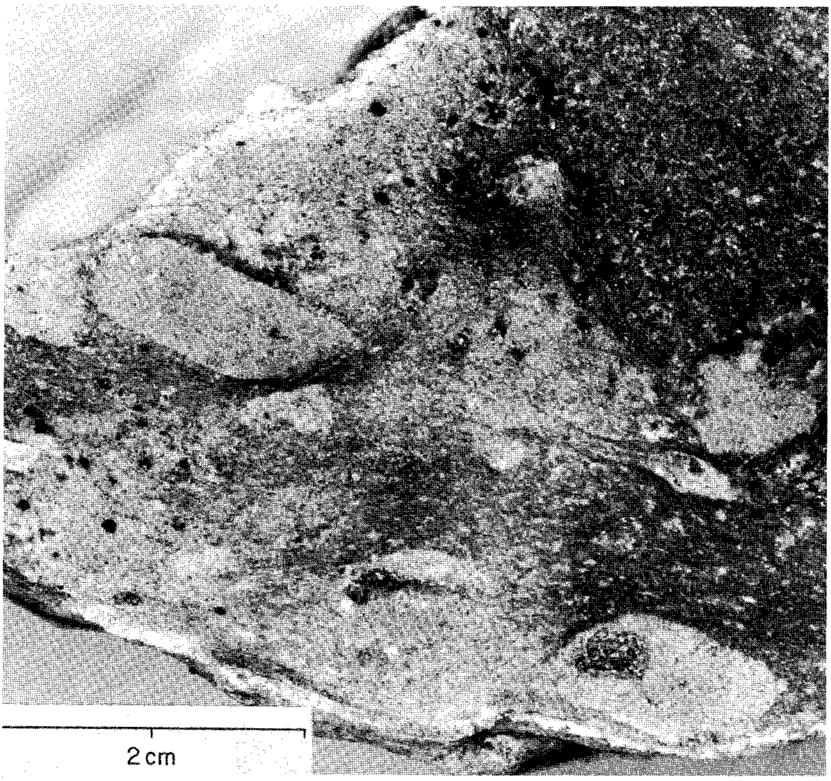

Figure 6. Sawed slab of mica schist (R-4726) containing sericite pseudomorphs after staurolite, Toms Knob at the north end of Fork Mountain, Snow Creek quadrangle.

in other samples has been retrograded to chlorite. Chloritoid is widespread in its occurrence and has grown as porphyroblasts up to 3 cm in diameter across foliation indicating static (postkinematic) growth. It is later than, and generally has grown in the sites of sericite, pseudomorphous after either regional staurolite (R-4720, Figure 7), or sillimanite. At places it is accompanied by minute second generation staurolite porphyroblasts (R-4722, Figure 8). Some chlorite shows signs of regrowth across foliation, contemporaneous with the growth of chloritoid. Kyanite occurs in the rock proximate to the igneous rocks of the Leatherwood Granite and the Rich Acres formation.

In the outer perimeter of the contact zone, the mica schist loses its schistose character and is recrystallized into a granoblastic muscovite hornfels (granofels, Plate 3) that is gradational into the garnetiferous

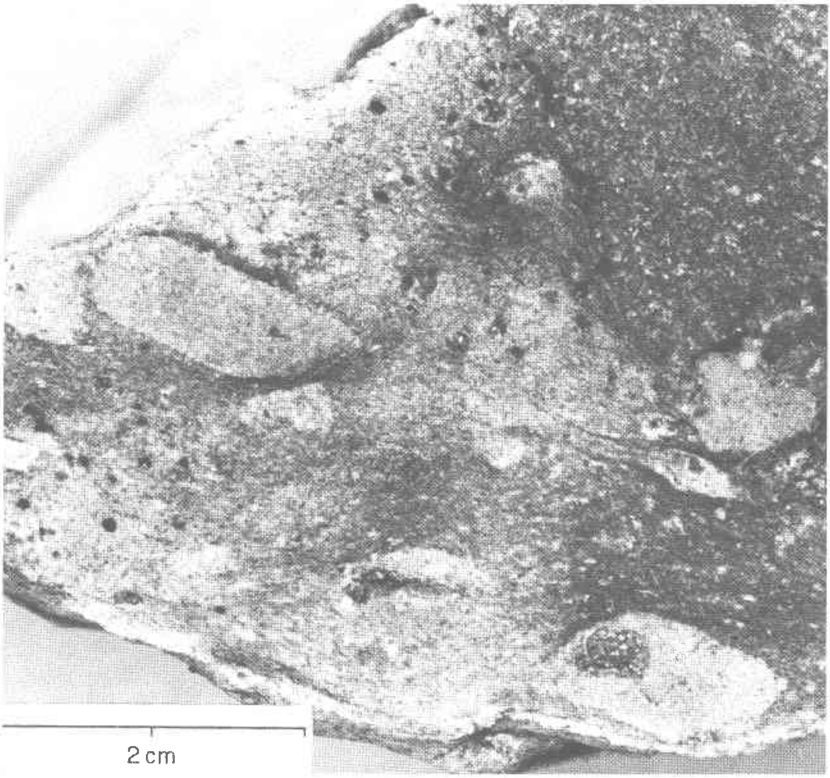

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Figure 7. Photomicrograph of mica schist (R-4720), northwest fork of Fork Mountain; light areas are retrograde sericite pseudomorphs after prograde staurolite which contain numerous later prograde (second prograde) twinned crystals of chloritoid; cross-polarized light.

biotite gneiss which in turn overlies the Leatherwood Granite and Rich Acres formation. The hornfels has a decussate texture (R-4721, Figure 9) and garnets are generally abundant, comprising as much

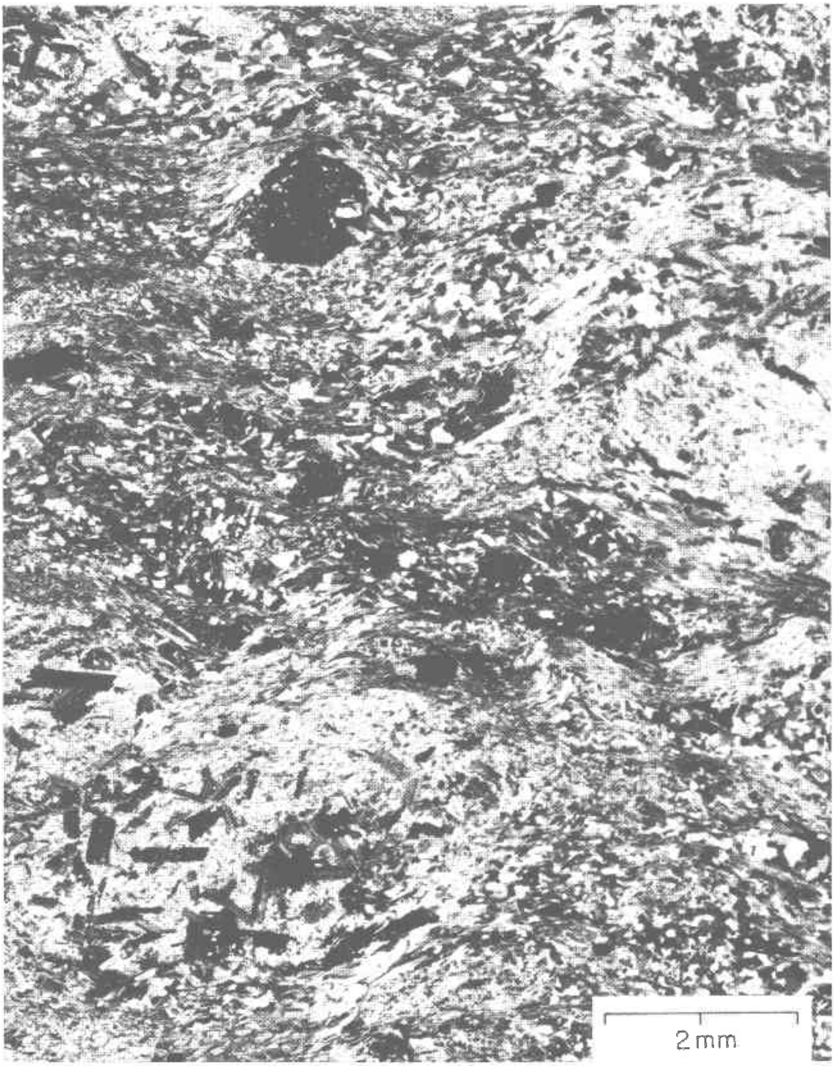

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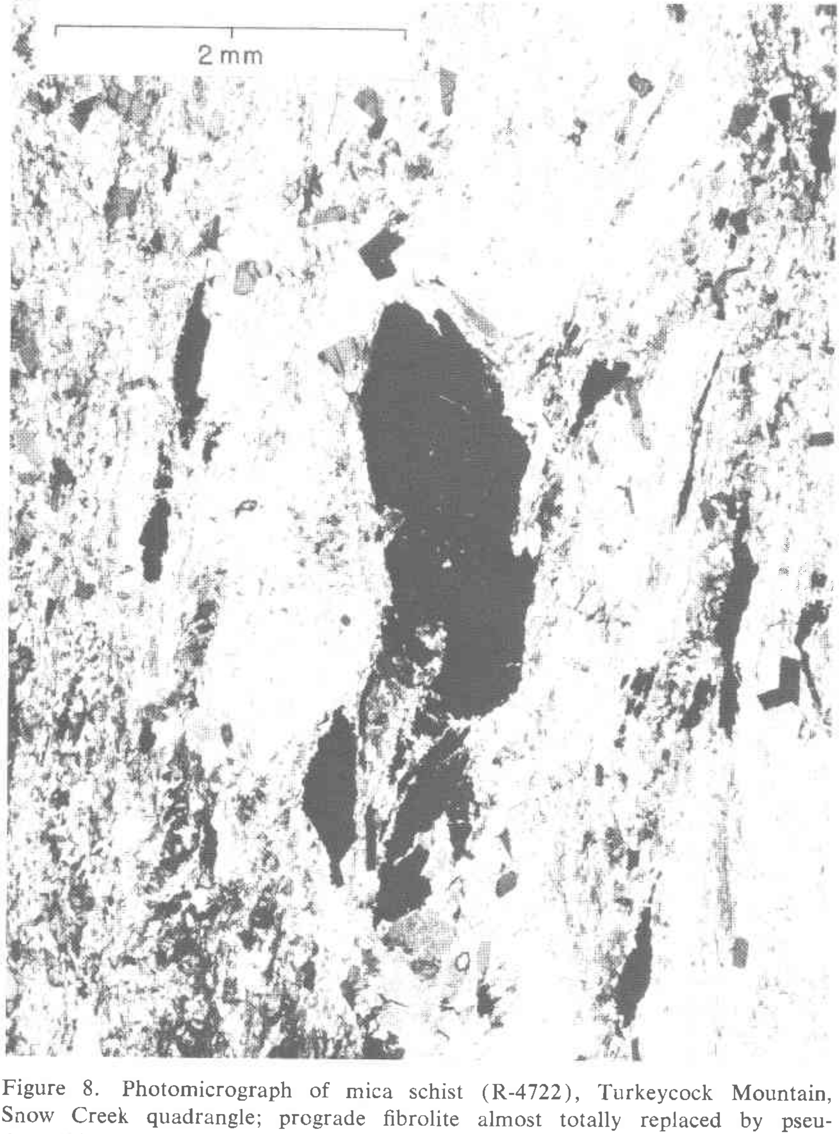
Figure 8. Photomicrograph of mica schist (R-4722), Turkeycock Mountain, Snow Creek quadrangle; prograde fibrolite almost totally replaced by pseudomorphous sericite; second prograde staurolite crystals associated with opaque minerals in and around sericite pseudomorphs after fibrolite; plane-polarized light.

as 15 to 30 percent. Garnets give the rock a spotted appearance and coalescing garnet porphyroblasts may produce coarse planar features. Staurolite, as minute grains, persists in some samples; kyanite is more



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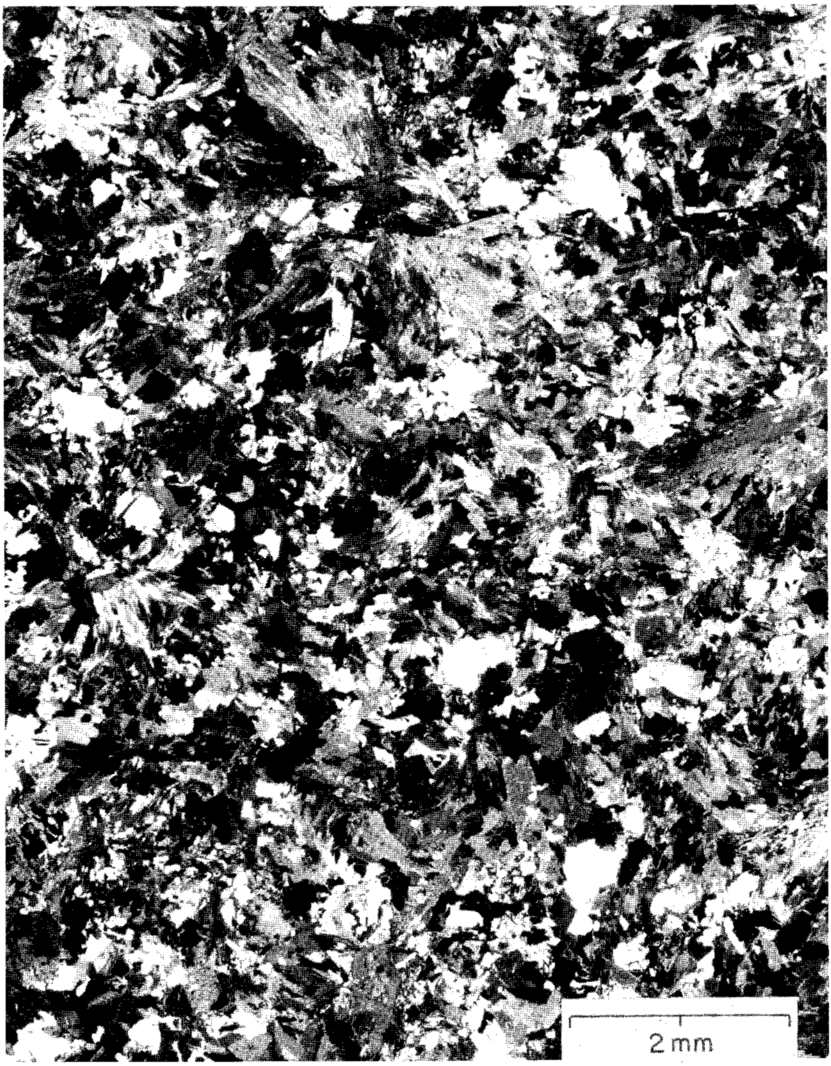

Figure 9. Photomicrograph of mica hornfels (R-4721), north of the intersection of State Road 662 and State Highway 57, in the Martinsville East quadrangle; cross-polarized light.

common and may compose from 15 to 30 percent of the rock. It is concentrated in sieve-textured pseudomorphs probably after staurolite (R-4729, Figure 10). A second prograde sillimanite appears in the matrix of the hornfels as fibrolite and as large, euhedral porphyroblasts

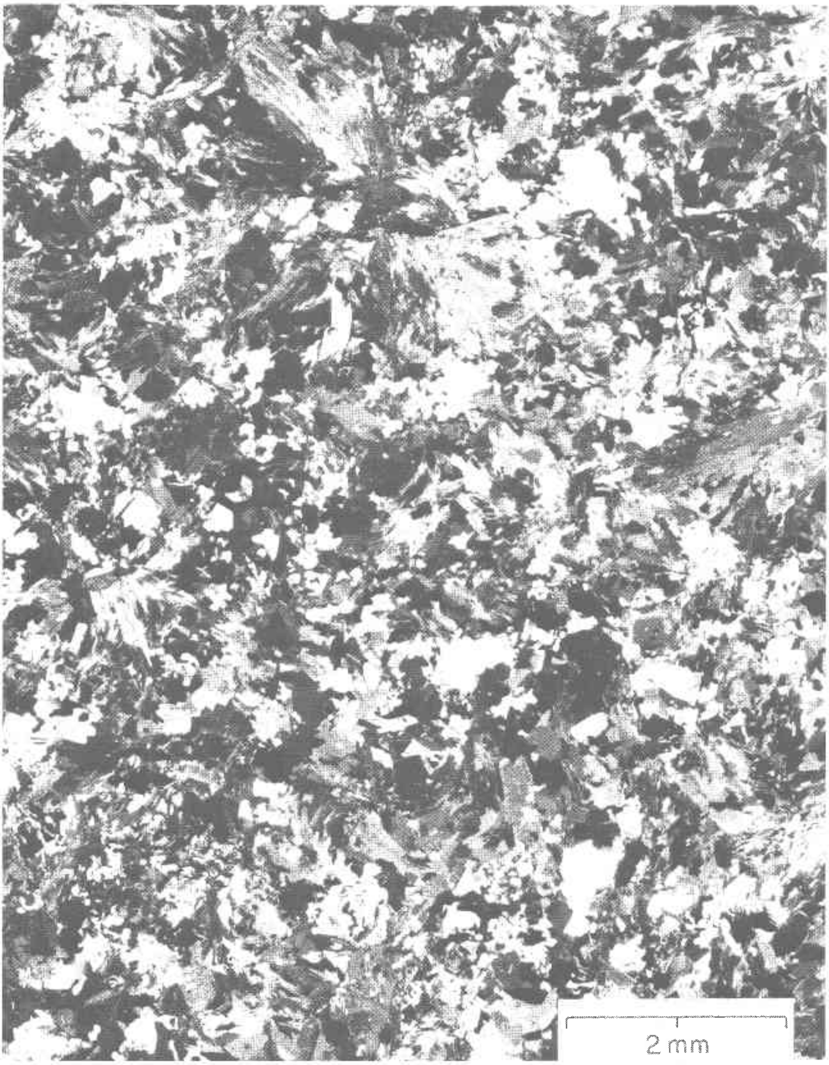

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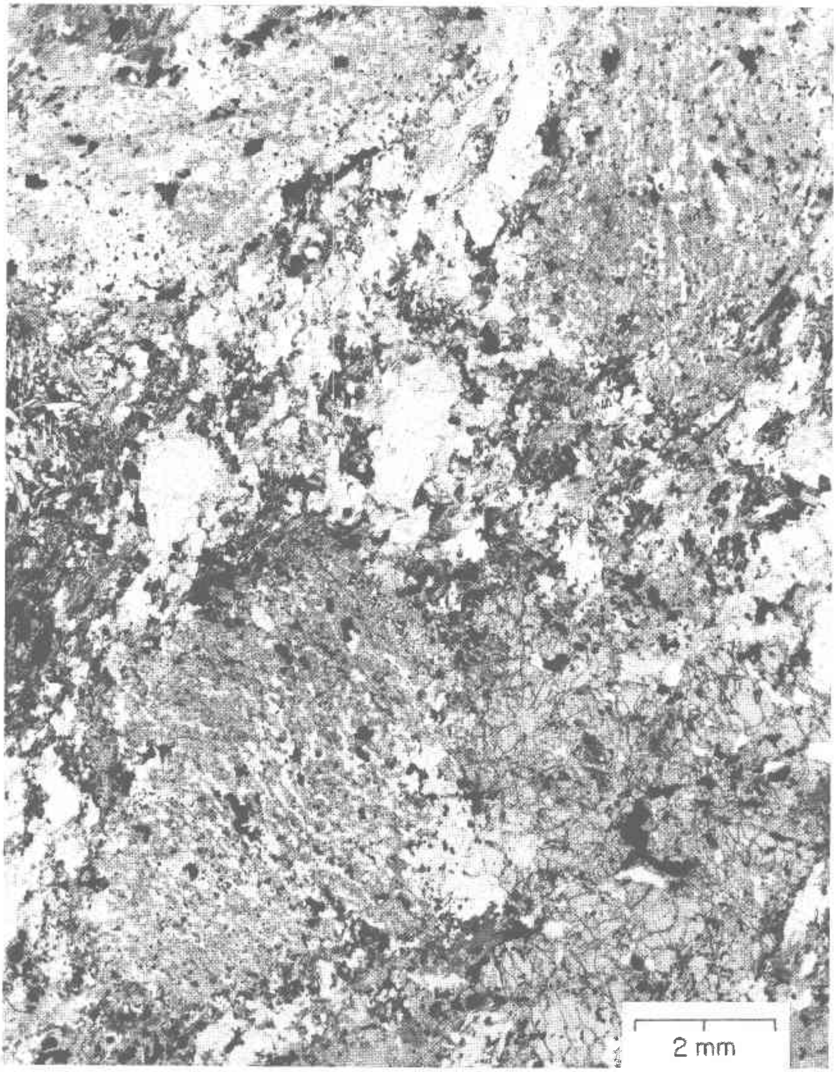
Figure 10. Photomicrograph of mica hornfels (R-4729), south of State Road 781 one mile southwest of the intersection with State Road 687, Price quadrangle.

(R-4724, Figure 11). Chloritoid, and generally chlorite, which occur above the hornfels zone, are here replaced by dark reddish-brown biotite.

Garnetiferous Biotite Gneiss

The garnetiferous biotite gneiss is a dark-gray segregation-banded gneiss that contains alternating quartzo-feldspathic- and biotite-rich



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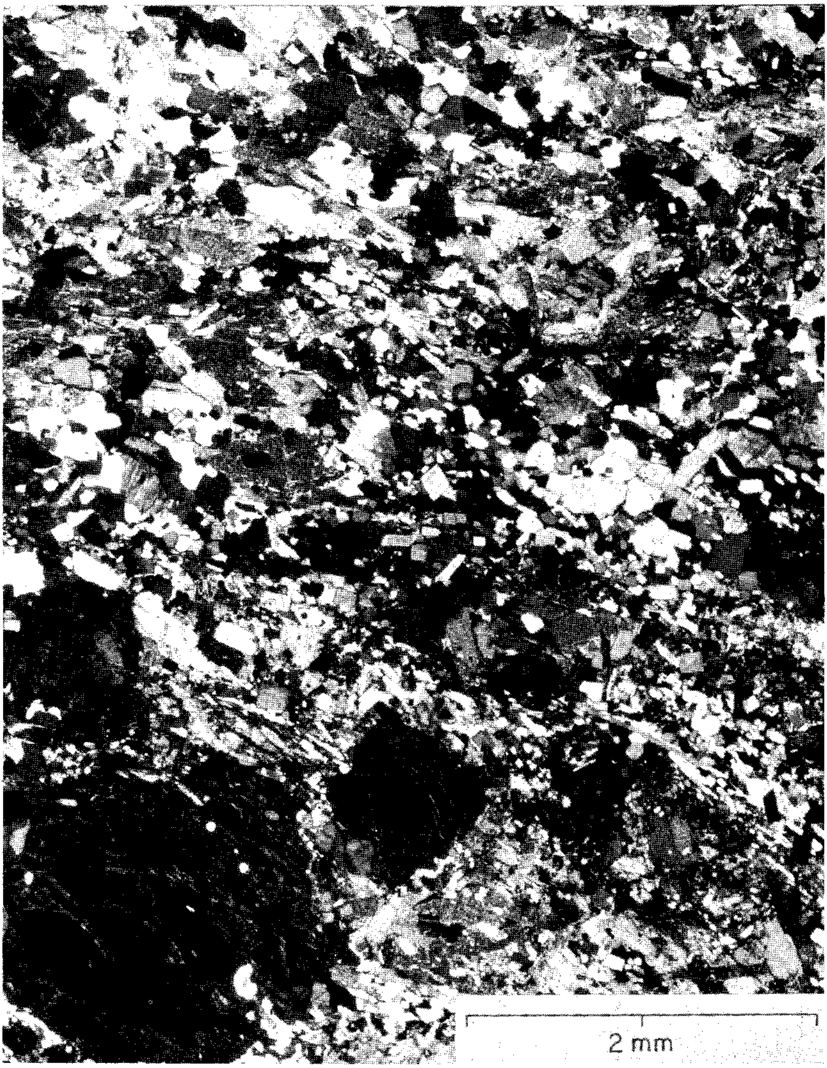
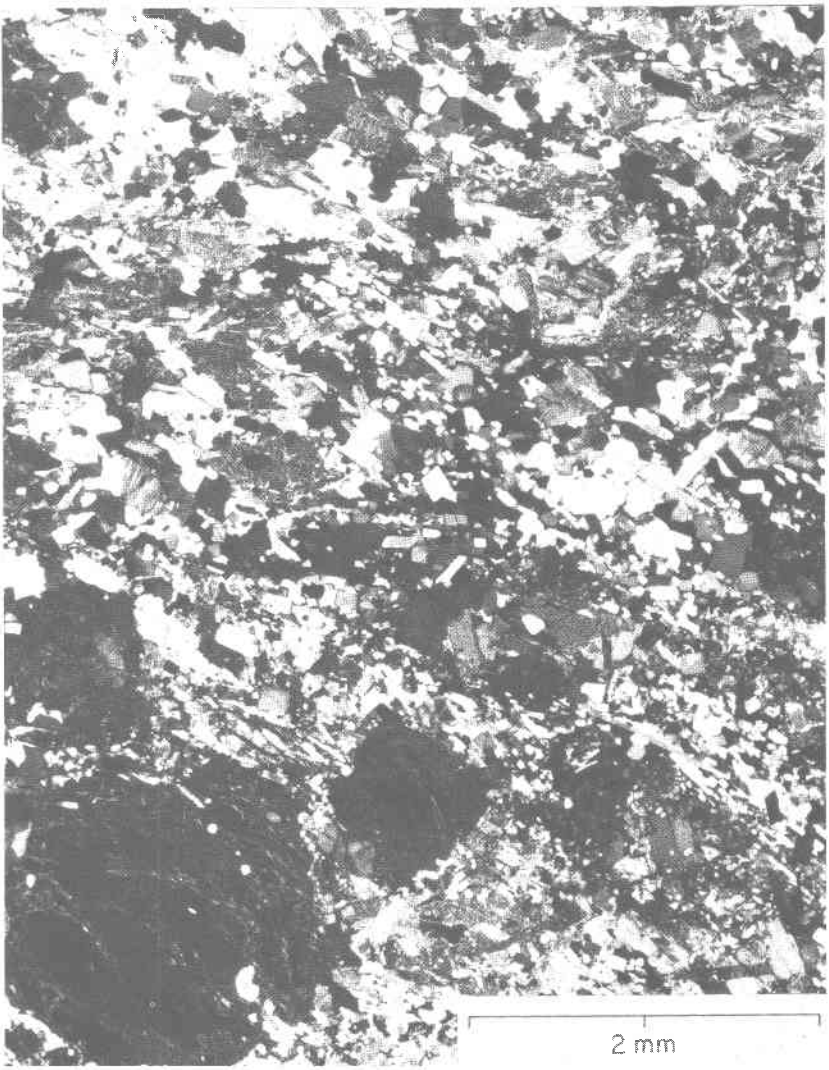


Figure 11. Photomicrograph of mica hornfels (R-4724), west side of State Road 781, south of Chestnut Knob fire tower; cross-polarized light.

layers. It is not resistant to weathering and decomposes to a characteristically pink saprolite and brown sandy soil. It marks the contact between the Fork Mountain formation and the Leatherwood Granite-Rich Acres formation and generally consists of an intensive metamorphic zone as much as 200 feet thick in which the Fork Mountain has been converted to the garnetiferous biotite gneiss (R-4681, Figure 12).



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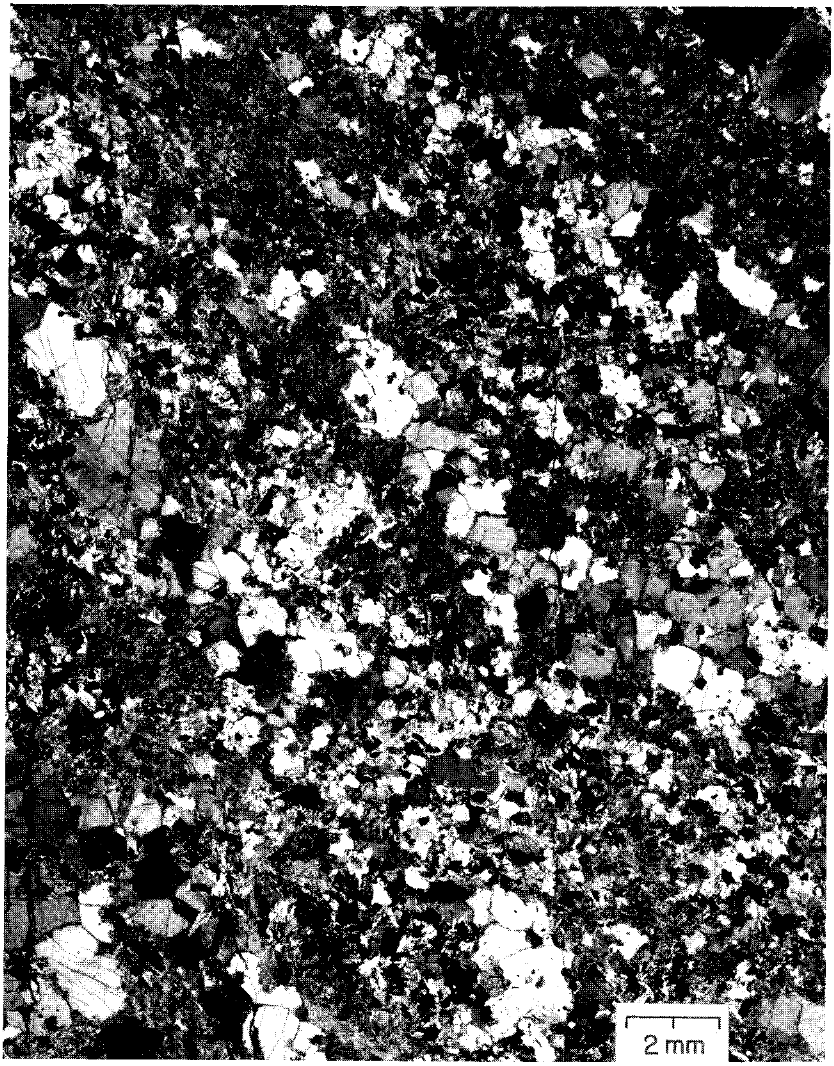
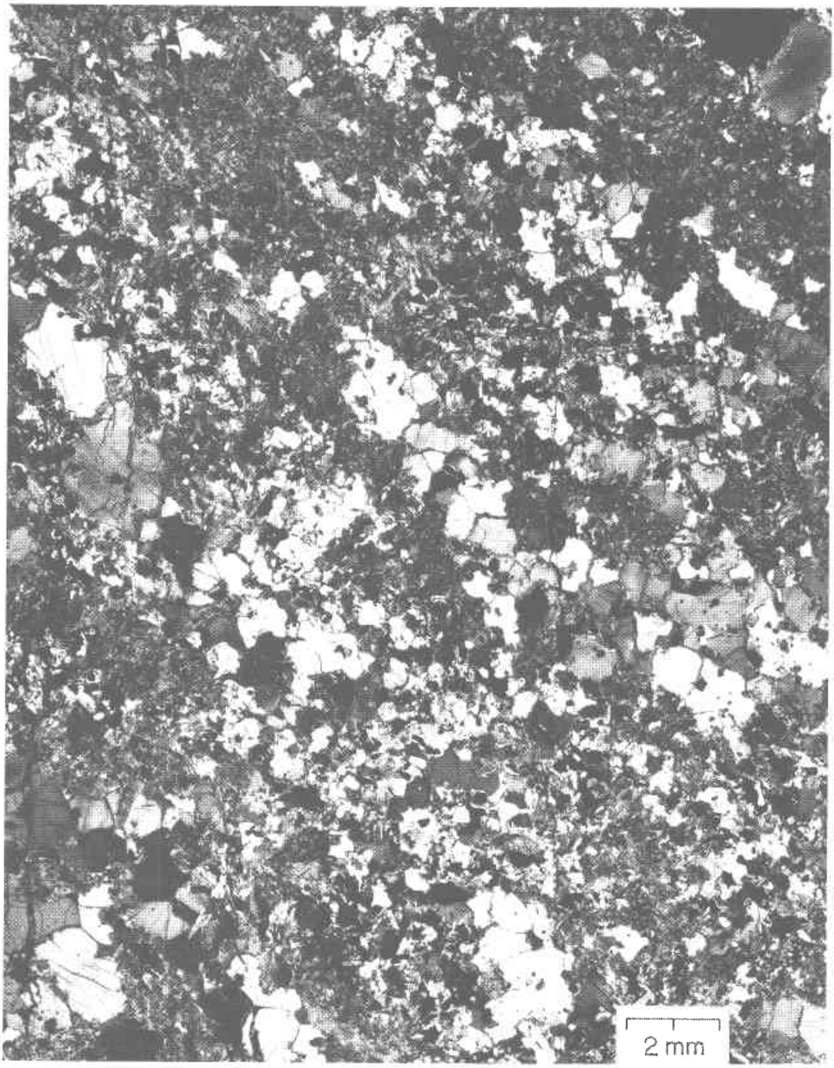


Figure 12. Photomicrograph of garnetiferous biotite gneiss (R-4681), Marrowbone Creek, Price quadrangle.

Layering is more pronounced and widely spaced nearer the contact with the igneous rocks. High-alumina assemblages of staurolite-kyanite and kyanite-sillimanite occur near the top of the gneiss but are gradually replaced by more feldspathic assemblages toward the Leatherwood and Rich Acres. Grain size also increases toward the igneous rocks, and



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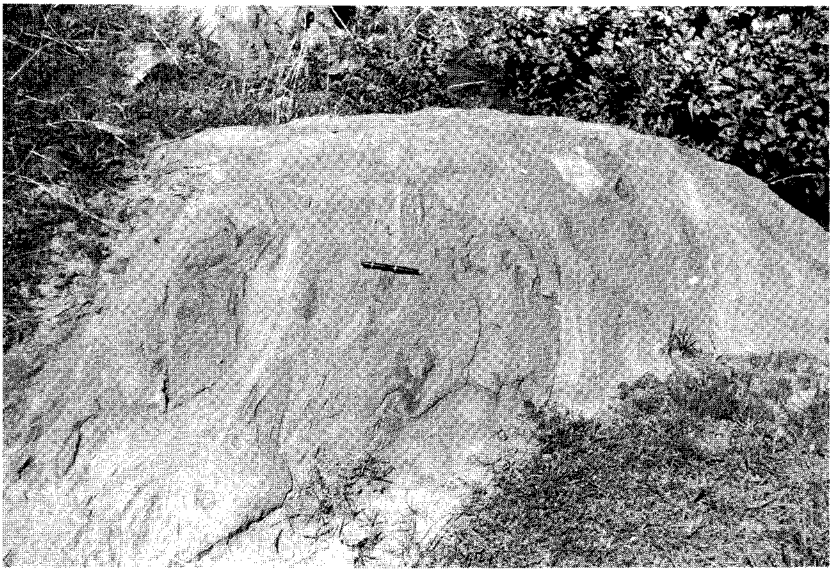

Figure 13. Garnetiferous biotite gneiss containing refractory lithic fragments in the matrix, southwestern end of Turkeycock Mountain.

near the contact with those rocks the gneiss (R-4636, Plate 2) has a chaotic foliation that is injected with pegmatites. Only the quartzite beds in the Fork Mountain remain as refractory relicts that occur as boudin-shaped masses even in the migmatitic gneiss (Figure 13). Some garnetiferous biotite gneiss near the contact with the igneous rocks contains abundant plagioclase porphyroblasts that are 0.8 mm-2 cm in diameter; they probably resulted from the reaction: quartz + muscovite + sodic plagioclase ⇄ sillimanite + soda-rich microcline + H_2O + more calcic plagioclase (Guidotti, 1963, p. 786). Some of the plagioclase grains are myrmekitic and some are patch antiperthites that show exsolved anorthoclase.

The rock is generally composed of 20 to 40 percent plagioclase (oligoclase to andesine), 20 to 45 percent quartz, 10 to 40 percent biotite, 2 to 30 percent garnet, and a trace to 40 percent microcline. Other minerals are muscovite, epidote, allanite, chlorite, opaque minerals including magnetite and sulphides, carbonate, apatite, sericite, kyanite, sillimanite, zircon, staurolite, tourmaline, spinel, hornblende, rutile, orthoclase, and corundum.

LEATHERWOOD GRANITE

The Leatherwood Granite consists of thin dikes that have cut the older gabbro of the Rich Acres formation, and sheet-like bodies at the

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LEATHERWOOD GRANITE

The Leatherwood Granite consists of thin dikes that have cut the older gabbro of the Rich Acres formation, and sheet-like bodies at the top of the Rich Acres. It is a coarse-grained, light-gray, porphyritic biotite granite, generally showing rapakivi texture, and can grade into leucogranite and pegmatitic leucogranite.

The formation is best exposed in the abandoned quarry on the north side of U. S. Highway 58, 0.9 mile east of where the highway crosses Horse Pasture Creek (R-4190, Plate 3). Other exposures are on the northwest bank of the Martinsville Reservoir northeast of the dam (R-4638, Plate 2), and in the headwaters of the West Fork of Leatherwood Creek south of Dyers Store (R-3711, Plate 2).

A tentative age of the Leatherwood Granite has been obtained by radiometric dating. Six samples of partially decomposed rock were collected in the Martinsville West quadrangle (five Leatherwood Granite samples and one Rich Acres formation sample) and zircon concentrates were made (Conley and Toewe, 1968, p. 27). A statistical study of the zircon populations from these concentrates indicate that they are of igneous origin and from the same magma. Zircons concentrated from three of the samples, two from the Leatherwood (R-3312 and R-3380) and one from the Rich Acres (R-3382) were analyzed for Pb-U isotopic abundances by Isotopes Incorporated. All samples showed considerable lead loss and discordant age dates. An assumed Precambrian lead model was selected and plotted on a concordia diagram. The plots of the samples define a chord that intersects a concordia curve at about 925 million years (Conley, Henika, and Algor, 1971). For greater accuracy a feldspar sample was collected at approximately the same locality as sample number R-3312 and analyzed for Pb isotopic abundances. Using the lead model obtained from analysis of the feldspar, it was found that the plots from the two Leatherwood samples and one Rich Acres sample fall on a chord with an upper intercept at 1020 million years for the age of the Leatherwood and Rich Acres and a lower intercept at zero, indicating a very recent lead loss, possibly from weathering (Figure 14). This data indicates that the Leatherwood Granite is contemperaneous with the Rich Acres and should be considered the felsic differentiate of the parent magma of the Rich Acres formation.

The Leatherwood weathers to a pinkish saprolite and light tan to red sandy soil. Phenocrysts weather to kaolinite blebs and occur as partly decomposed fragments in the soil. The rock is composed of 30 to 60 percent microcline, 10 to 30 percent plagioclase (oligoclase in part patch antiperthite), 20 to 30 percent quartz, 5 to 15 percent biotite, and a trace to 15 percent muscovite. Minerals in amounts less than 2 percent are epidote, clinozoisite, apatite, sphene, zircon, and opaques. The microcline phenocrysts are salmon to purplish gray,

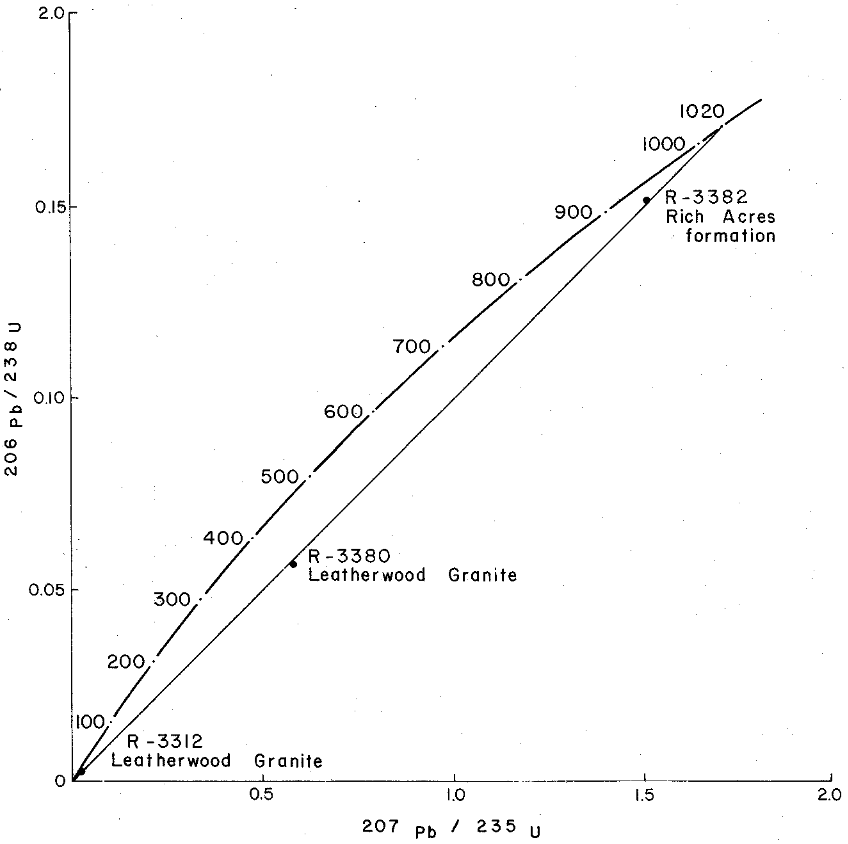


Figure 14. Concordia diagram showing age of the Leatherwood Granite and the Rich Acres formation.

carlsbad-twinned, perthitic, and rimmed by intergrown myrmekitic oligoclase and fine-grained microcline (R-4439, Figure 15). In some instances the myrmekitic plagioclase embays the microcline phenocrysts. The rock may show cataclastic margins around large phenocrysts (R-4638, Plate 2). Plagioclase contains epidote and clinozoisite inclusions from alteration, and microcline may be slightly sericitized.

Alaskite and pegmatite in the formation contain more microcline, quartz, and muscovite and less plagioclase and biotite than the typical Leatherwood Granite. The microcline phenocrysts are larger than in the granite and are as much as 4 cm across. Some have rapakivi texture (R-4189, Plate 2).

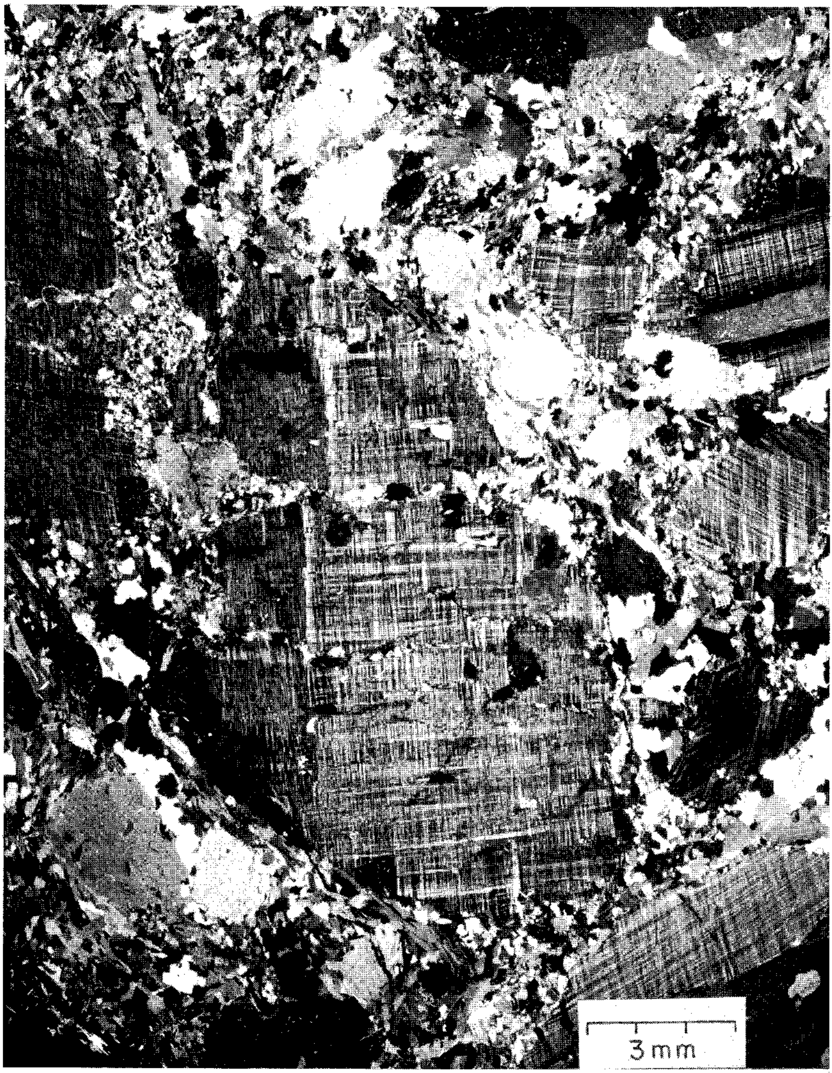
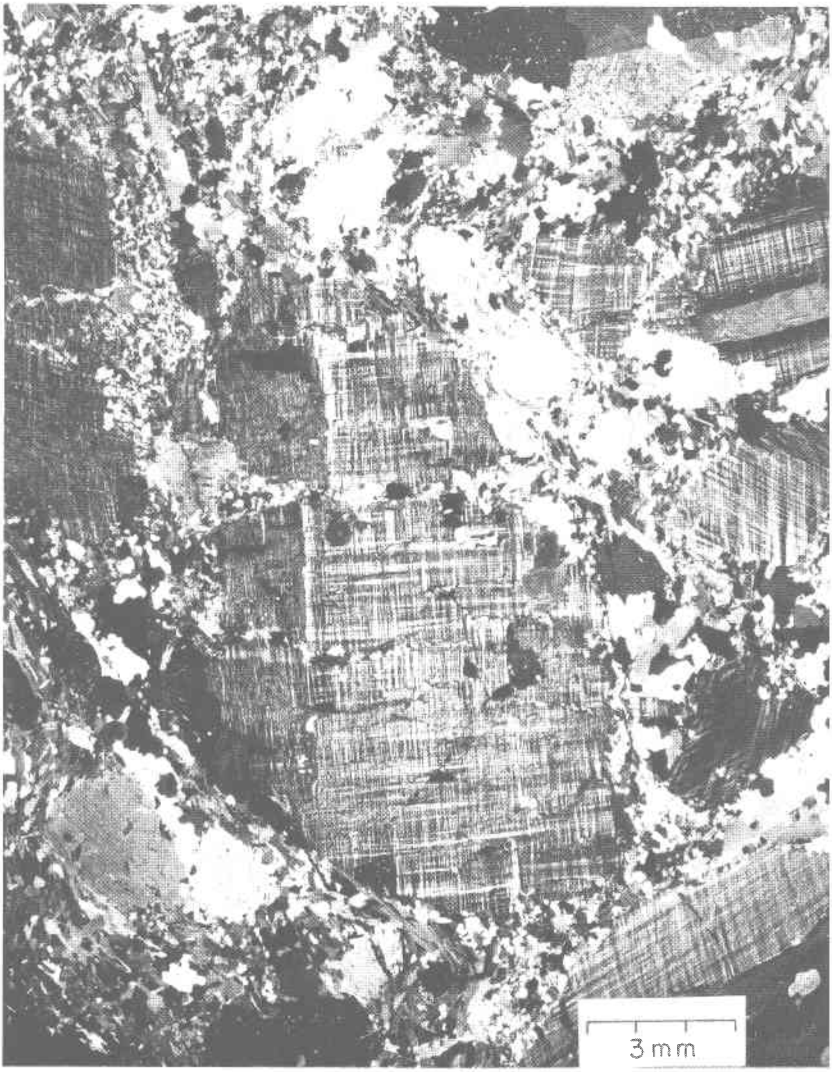


Figure 15. Photomicrograph of the Leatherwood Granite containing large microcline phenocrysts surrounded by fine-grained quartz and feldspar (R-4439), railroad bridge at Fontaine, Martinsville East quadrangle.

RICH ACRES FORMATION

The Rich Acres Norite was formally named for exposures of norite northwest of the Rich Acres Christian Church in the Rich Acres community by Conley and Toewe (1968). During the present study,



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Gabbro

The gabbro is medium to fine grained, equigranular, and medium gray. Areas underlain by the gabbro are generally lowlands that have a gentle rolling topography. Extensive tan to brown, massive, deep saprolite and thick dark-brown to maroon soils rich in clay and iron oxides are developed on the bedrock. It generally crops out as spheroidal boulders (Figure 16).

The rock is composed of 30 to 70 percent plagioclase (bytownite-labradorite); 5 to 15 percent orthopyroxene; 5 to 20 percent clinopyroxene (augite); 6 to 20 percent biotite; 7 to 40 percent hornblende; 2 to 9 percent magnetite, and traces of epidote, sphene, ilmenite,

Figure 16. Gabbro that shows typical exfoliation joints and rounded profile, in a stream valley northwest of Nantes Mountain, Martinsville East quadrangle.

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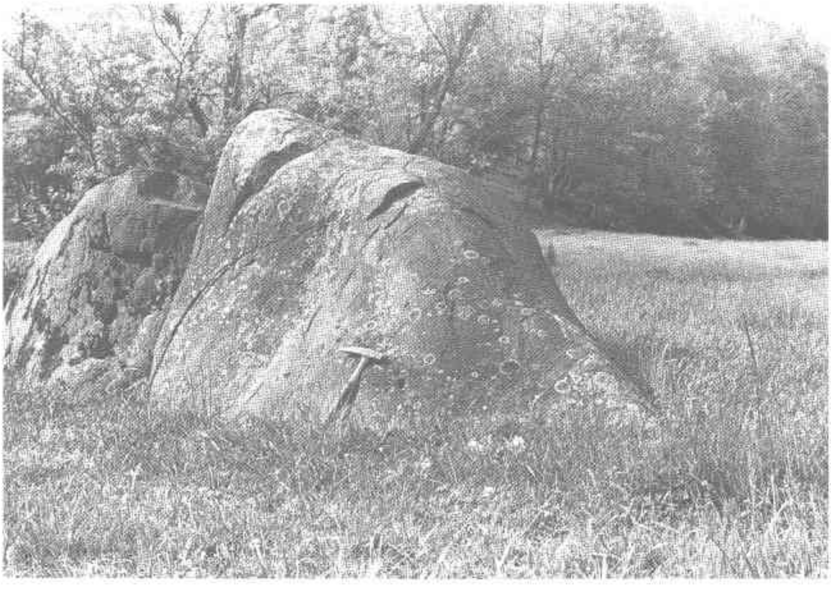

Figure 16. Gabbro that shows typical exfoliation joints and rounded profile, in a stream valley northwest of Nantes Mountain, Martinsville East quadrangle.

pyrite, quartz, carbonate, rutile, apatite, zircon, sericite, actinolite (including uralite) and sphene. One sample contains 20 percent pargasite. The rock generally shows the development of uralite and quartz from pyroxene and amphibole. Plagioclase is partially replaced by epidote, and biotite is altered to chlorite. The primary inequigranular

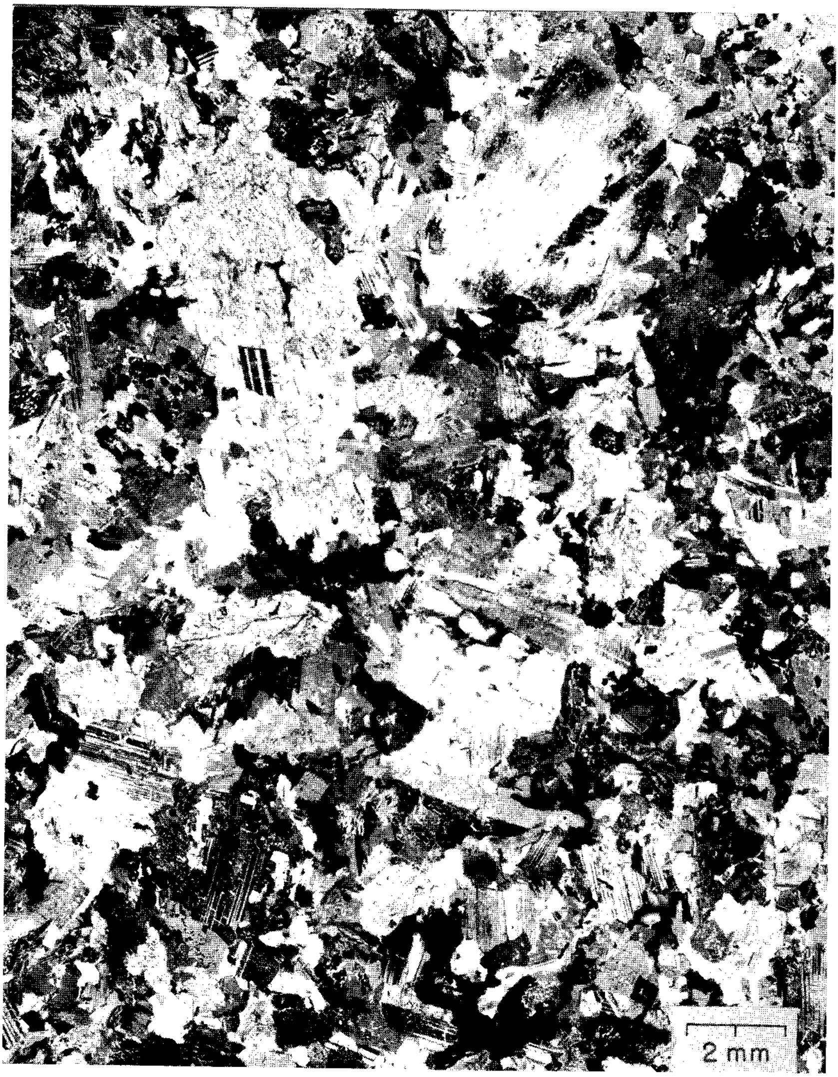

Figure 17. Photomicrograph of hornblende diorite (R-4436), along State Highway 57 at the southeastern end of Nantes Mountain, Snow Creek quadrangle; cross-polarized light.

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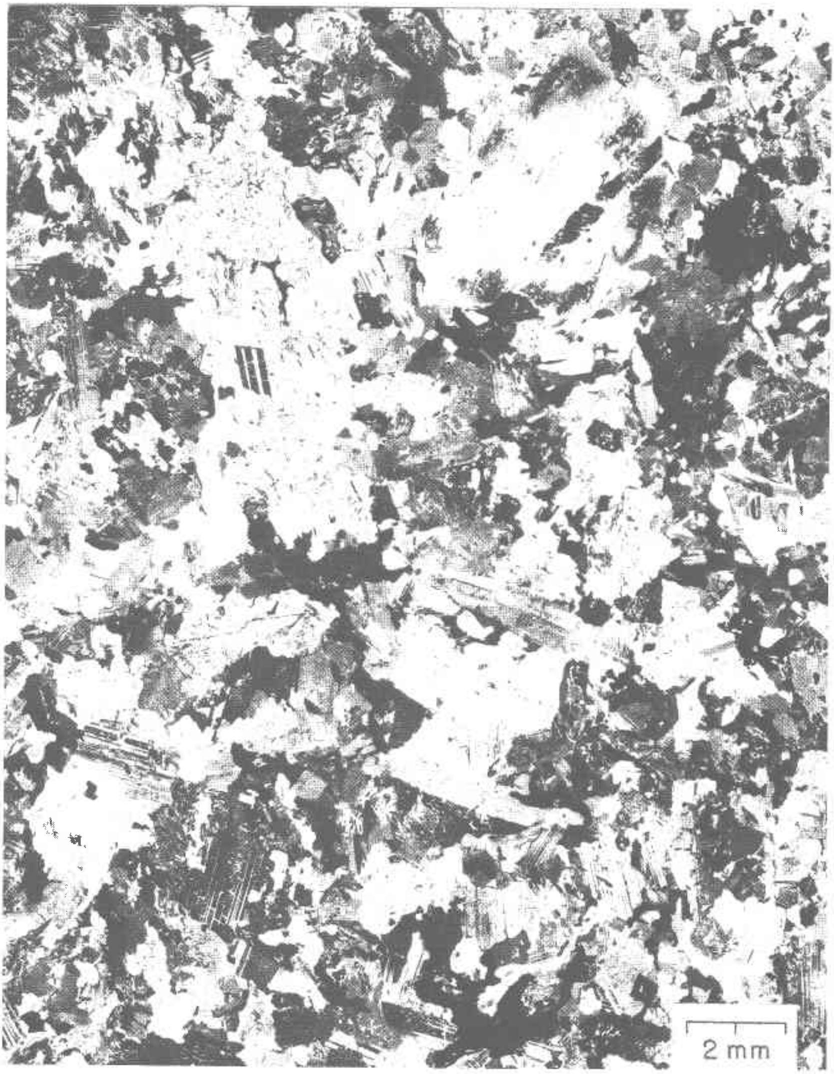

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medium-grained igneous texture is largely destroyed by this later mineral growth, producing a fine-grained granoblastic metamorphic rock. In several places, especially along the fault at Ridgeway (Plate 3), the gabbro has a slight foliation and less commonly is schistose.

Diorite

The diorite is medium to coarse grained, generally porphyritic, and medium-grayish green (R-4436, Figure 17). It is more resistant to weathering than either the norite or the gabbro. It has intruded the gabbro along Mulberry Creek; along U. S. Highway 58 between the western Martinsville city limits and State Road 659 (R-3847, R-4444, Plate 2); and along a tributary of Reservoir No. 2 just south of State Road 658 (R-3789, Figure 18). Inclusions of both gabbro and granite occur in diorite in the area northwest of Nantes Mountain (R-4434, Plate 2).

Figure 18. Detail of rock in Figure 16 showing gabbro veined by light-colored diorite; circular masses are lichen.

The rock is composed of 40 to 70 percent plagioclase (andesine to oligoclase), 5 to 30 percent hornblende, 5 to 15 percent biotite, and 1 to 15 percent quartz. Augite is generally present and ranges medium-grained igneous texture is largely destroyed by this later mineral growth, producing a fine-grained granoblastic metamorphic rock. In several places, especially along the fault at Ridgeway (Plate 3), the gabbro has a slight foliation and less commonly is schistose.

Diorite

The diorite is medium to coarse grained, generally porphyritic, and medium-grayish green (R-4436, Figure 17). It is more resistant to weathering than either the norite or the gabbro. It has intruded the gabbro along Mulberry Creek; along U. S. Highway 58 between the western Martinsville city limits and State Road 659 (R-3847, R-4444, Plate 2); and along a tributary of Reservoir No. 2 just south of State Road 658 (R-3789, Figure 18). Inclusions of both gabbro and granite occur in diorite in the area northwest of Nantes Mountain (R-4434, Plate 2).

Figure 18. Detail of rock in Figure 16 showing gabbro veined by light-colored diorite; circular masses are lichen.

The rock is composed of 40 to 70 percent plagioclase (andesine to oligoclase), 5 to 30 percent hornblende, 5 to 15 percent biotite, and 1 to 15 percent quartz. Augite is generally present and ranges from 3 to 20 percent, but orthopyroxene occurs in less than half the samples examined. Accessory minerals are chlorite, ilmenite-magnetite, pyrite, carbonate, epidote, apatite, zircon, sphene, tourmaline, muscovite, and rutile.

Norite

The norite is dark gray to almost black and medium- to coarse-grained. Textures range from granular to ophitic although most specimens are subophitic and some are porphyritic. The phenocrysts are composed of almost equidimensional plagioclase up to 1 cm across and large poikilitic pyroxenes up to 2 cm across.

The norite is composed of 30 to 60 percent plagioclase (bytownite-labradorite), 10 to 38 percent orthopyroxene (predominantly hypersthene), 5 to 15 percent augite, 10 to 20 percent amphibole, and less than 1 to 10 percent biotite. Olivine is not always present but can comprise as much as 20 percent of the rock. Accessory minerals are opaques (predominantly magnetite, but some ilmenite and pyrite), spinel, carbonate, apatite, and zircon. It also contains the alteration minerals iddingsite after olivine, chlorite after biotite, and carbonate, epidote, and sericitic mica after plagioclase.

Orthopyroxene is present as reaction rims around olivine (R-4727, Figure 19), phenocrysts in the matrix, and exsolution lamellae in clinopyroxene; amphibole as brown-green phenocrysts in the matrix, green reaction rims on pyroxene, and large primary reddish-brown poikilitic grains of pargasite that fill the interstices between plagioclase grains; and spinel as inclusions in hornblende and pyroxene.

LYNCHBURG FORMATION

The Lynchburg Formation occurs in the northwestern part of the Snow Creek quadrangle in a narrow band approximately 0.5 mile wide. Brown (1958, p. 23) considers Catoctin greenstone to be at, or near, the top of the Lynchburg Formation. Rankin and others (1969) have dated a rhyolite from the base of the Catoctin just west of Gettysburg, Pennsylvania, as well as felsic metavolcanic rocks from the Mount Rodgers area, Virginia and the Grandfather Mountain window, North Carolina. All of these are discordant ages, but define a chord intersecting an original age of 820 million years. As Brown (1958) believes that the Catoctin is interbedded with the top of the Lynchburg, then this age date is a minimum age for the Lynchburg and confirms a late Precambrian age (Espenshade, 1970, p. 202; Brown, 1958, p. 18).

The Lynchburg consists of a basal lensoidal quartzite that grades

Figure 19. Photomicrograph of olivine norite (R-4727), one mile west of Dyers Store, Snow Creek quadrangle; cross-polarized light.

laterally southwestward into metagraywacke conglomerate, and vertically and northeastward along strike into mica schist and gneiss. The Lynchburg contains thin concordant bodies of metagabbro. Along the Bowens Creek fault the formation and the overlying rocks of the Smith River allochthon have been crushed and metamorphosed into muscovite-chlorite schist, phyllite, and phyllonite ("Cs" on Plate 1).

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Quartzite is exposed along U. S. Highway 220 (R-4627, Plate 1), and in the milled zone of the Bowens Creek fault along Muddy Fork Creek. Where fresh it is light to medium gray; where weathered it is tan and decomposed to a friable quartzose rock. It is composed predominantly of quartz, and contains microcline, muscovite, and biotite.

Interbedded metagraywacke and conglomeratic metagraywacke are exposed along State Highway 220 near Big Chestnut Creek (Figure 20).

Figure 20. Laminated metagraywacke at the base of the Lynchburg Formation along U. S. Highway 220 south of Big Chestnut Creek, Snow Creek quadrangle.

The metagraywacke consists of dark-gray beds ranging from 4 inches to several feet thick, and is composed of 1-2 mm-size grains of quartz, microcline, plagioclase, muscovite, biotite, and chlorite. The metaconglomeratic interbeds are generally thicker and lighter colored than the metagraywacke beds. They are composed of 0.5-3.0 cm clasts of quartz and microcline in a fine clastic matrix of quartz, feldspar, mica, epidote, chlorite, and opaques.

The mica schist is exposed around a farm pond approximately 0.5 mile south of State Road 718. It is silver gray and weathers to tan saprolite, and is composed predominantly of muscovite and sericite with lesser amounts of quartz, plagioclase, biotite, and opaques. Graphite-rich and chlorite-rich bands are dispersed throughout the

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Metagabbro

Two small concordant bodies of metagabbro, intrusive into the Lynchburg, occur along the extreme northwestern boundary of the Snow Creek quadrangle (R-4628, Plate 1). The metagabbro is generally coarse grained and equigranular; relict diabasic texture is preserved in the most southeasterly pluton. Where sheared, the predominant lithology is a schist with subordinate gneiss. The metagabbro is composed of actinolite, plagioclase, epidote, chlorite, and quartz.

GNEISS AND MICA SCHIST

Rocks, possibly correlative with the Lynchburg Formation, are exposed in the Sauratown Mountains anticlinorium southeast of the Ridgeway fault. The rocks consist of garnet-mica schist that overlies the basement of granitic augen gneiss and in turn is overlain by muscovite and muscovite-biotite gneiss.

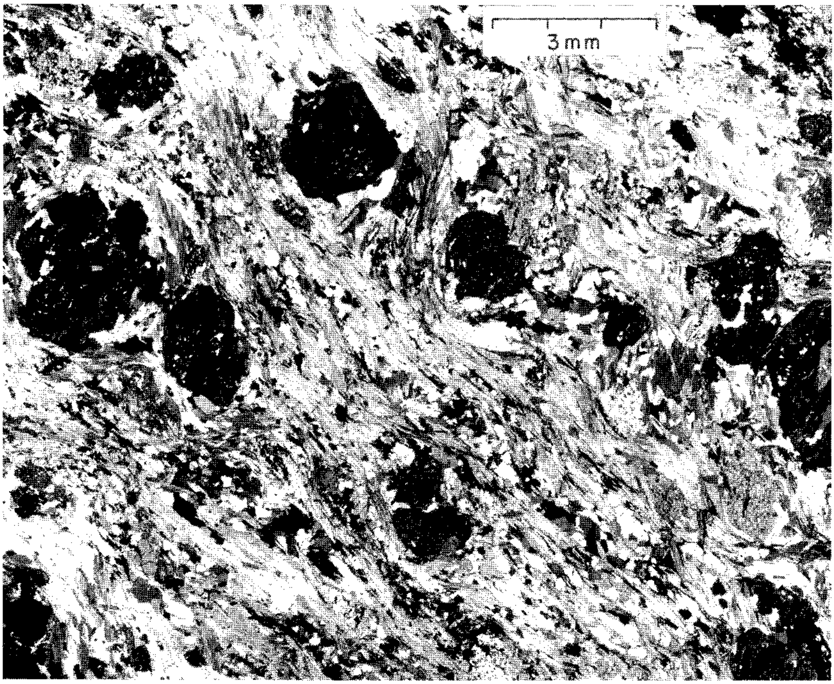

Figure 21. Photomicrograph of cataclastically deformed mica schist (R-4645) just southeast of the Ridgeway fault; cross-polarized light.

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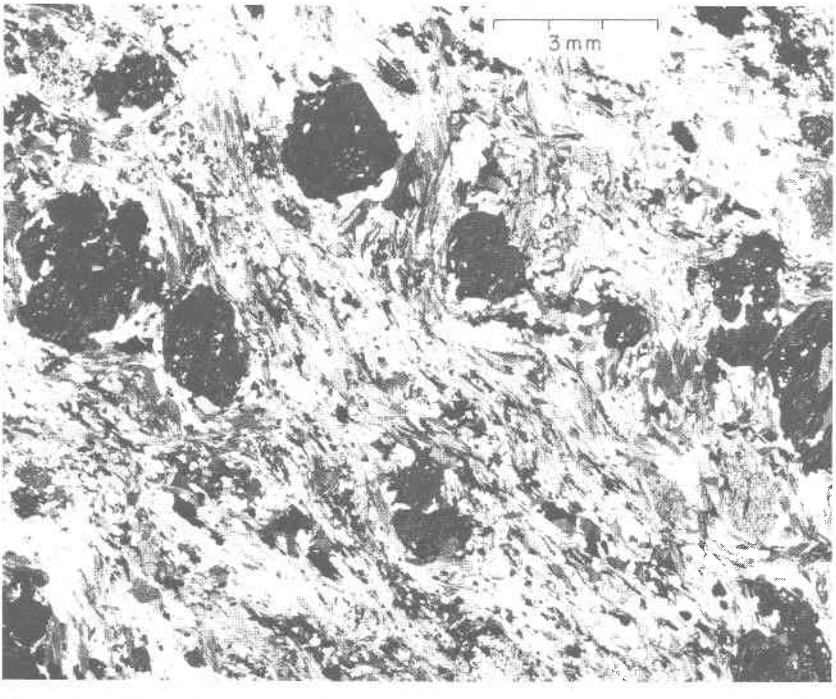

Figure 21. Photomicrograph of cataclastically deformed mica schist (R-4645) just southeast of the Ridgeway fault; cross-polarized light.

Garnet-Mica Schist

The garnet-mica schist is well exposed along State Highway 87 from a point approximately 1.0 mile southeast of Ridgeway to a point approximately 1.2 miles southeast of the town limit (Plate 3). The garnet-mica schist contains thin layers of graphitic mica schist and garnet-hornblende gneiss and schist (R-4666 and R-4667, Plate 3) near its base along State Highway 87 and at other localities northeastward and southwestward. Micaceous quartzite and a lenticular layer of calcareous gneiss form a distinctive zone near the base of the schist in the eastern part of the Spray quadrangle.

The garnet-mica schist is shiny and silvery gray, weathered exposures are commonly yellowish tan, and the soil developed over the schist contains abundant residual garnets. Graphitic interbeds are generally dark gray and less garnetiferous.

The schist contains as much as 20 percent rose to red garnet up to 4 mm diameter, some of which have spiral trains of inclusions. Near the Ridgeway fault the garnets are granulated on their edges and the

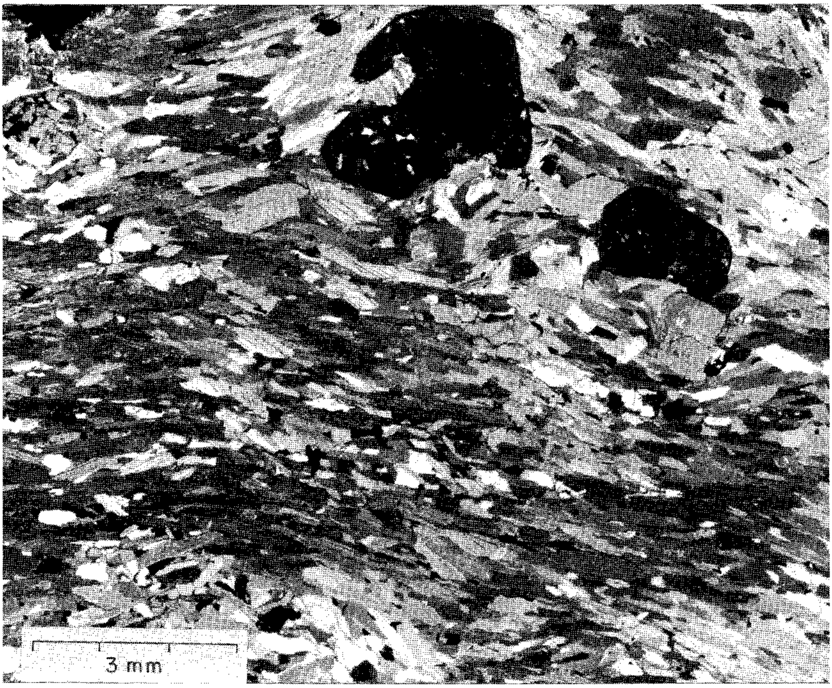

Figure 22. Photomicrograph of mica schist (R-4643), south side of State Road 640 about 2 miles northwest of Ridgeway; cross-polarized light.

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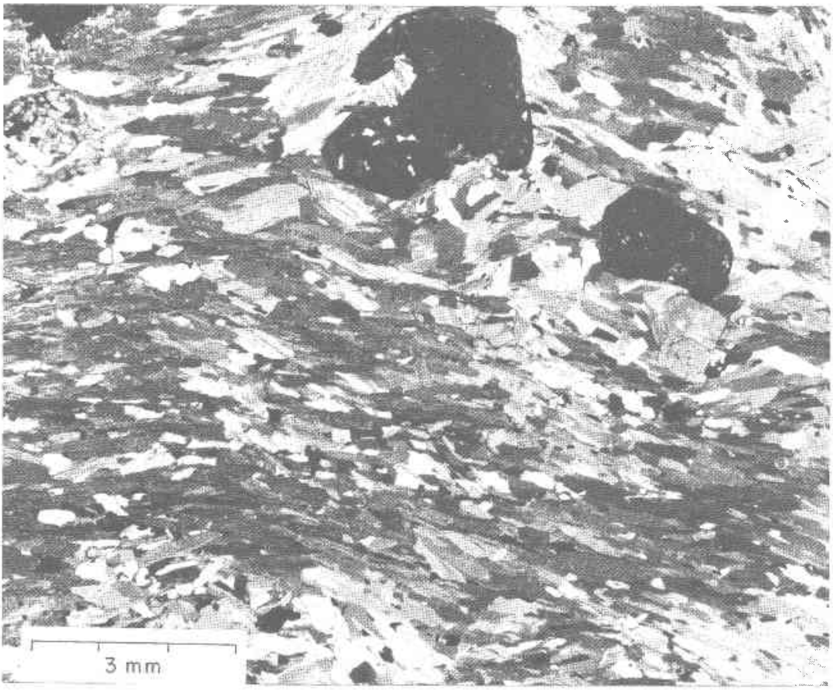

Figure 22. Photomicrograph of mica schist (R-4643), south side of State Road 640 about 2 miles northwest of Ridgeway; cross-polarized light.

mica folia wrap around them (Figure 21, R-4645, Plate 3). Muscovite blasts up to 5 mm diameter that have a subparallel orientation make up from 10 to 60 percent of the rock (R-4643, Figure 22). Biotite blasts, which are red-brown in thin section, compose as much as 40 percent; they are generally intergrown with muscovite and commonly contain inclusions of rutile and zircon. Quartz and plagioclase, 0.2-1.5 mm in diameter, are concentrated in lenticular bands that pinch and swell along the cleavage. Quartz constitutes from 5 to 30 percent; plagioclase content from a trace to 25 percent.

Kyanite is common in the schist and occurs as lath-shaped porphyroblasts up to 1 cm diameter intergrown with the mica along the schistosity. Staurolite (R-3791, Plate 2), when present, constitutes as much as 10 percent of the rock and is generally unaltered, black, non-twinned prismatic crystals up to 2.0 cm in length.

Chlorite, generally rare, is abundant in intensely deformed schist adjacent to the Ridgeway fault (R-3794, Plate 2). It has formed pseudomorphic replacements of biotite and peripheral alterations of garnet, indicating some retrograde metamorphism of the schist. Other minerals that occur in minor amounts are epidote, sphene, rutile, zircon, and opaques.

The schist contains gneissic layers that are completely gradational with the more typical schist lithology. These gneissic layers are mineralogically similar to the enclosing schist, except they are generally richer in quartz and feldspar and have a more granoblastic texture.

Micaceous quartzite and calcareous gneiss in the mica schist form resistant ledges along Turkeycock Creek (R-4651, R-4652, R-4653, Plate 3) that consist of dark-brown to gray massive beds which show faint banding on water-worn, smooth surfaces. Feldspar clasts and blue quartz pebbles are resistant to abrasion and stand out in relief on these surfaces.

The micaceous quartzite has a granoblastic texture with parallel mica laths scattered through the matrix. It contains about 70 percent quartz and 5 to 15 percent feldspar. The feldspar consists of elongate grains 0.3-0.6 mm in length, interlocked with quartz grains and as large polycrystalline aggregates (relict clasts) that are as much as 3 mm diameter. "Phantom" pebbles are visible in thin section; in plane-polarized light, their rounded outlines are delineated by concentrations of biotite and opaque minerals along original grain boundaries. Biotite comprises about 10 percent of the rock; it is brown in plane light and commonly intergrown with muscovite. Sphene and rutile occur in minor amounts, interspersed with opaque minerals.

The calcareous gneiss (R-4653, Plate 3) contains approximately 25 percent calcite, 25 percent plagioclase, 20 percent quartz, 15 percent biotite, and 10 percent muscovite. The calcite crystals are up to 5 mm diameter and are easily recognized in hand specimens. They are intergrown with quartz and plagioclase in the granular matrix of the rock. The biotite has a red tint in thin section and is intergrown with muscovite in discontinuous mica-rich layers. Fine-grained sphene, allanite-epidote, and zircon are also concentrated along the foliation.

Muscovite and Muscovite-Biotite Gneiss

The transition between the muscovite and muscovite-biotite gneiss and the underlying garnet-mica schist is well exposed along Fall Creek (R-4656, Plate 3) and along Smith River in the northeastern part of the Spray quadrangle; the base of the gneiss is separated from the schist by a persistant layer of garnet-hornblende schist. Similar garnet-hornblende layers also occur higher in the gneiss in the Martinsville East quadrangle.

The predominant lithology is muscovite-biotite gneiss that contains many interlayers of pure mica schist. Pebbly quartzose gneiss and feldspathic quartzite are interlayered with the gneiss in the Spray and Martinsville East quadrangles. Alaskite dikes and sills are common throughout the unit. They seem to be concentrated in the transition zone between the mica schist and gneiss units in the northern part of the Spray quadrangle and almost obliterate the gneiss in the Martinsville East quadrangle. Stratiform bodies of altered ultramafic rocks are common in the gneiss southeast of Ridgeway.

The gneiss is deeply weathered, but a characteristic saprolite has developed on the unit that consists of gray to tan, granular bands, rich in quartz and kaolinitized feldspar fragments, alternating with pure micaceous bands that stand out in relief in exposures.

Fresh outcrops are present in cliffs along Smith River and in tributary stream valleys. They contain gneissic layers 2 to 10 feet thick (R-4655, Plate 3) that are separated by layers of pure mica schist (R-4654) less than a foot thick. The gneiss is medium-grained, light-gray, and contains parallel mica plates interspersed with elongate grains of quartz and feldspar. The quartz content is variable, ranging from 20 percent in gneiss beds to 70 percent in feldspathic quartzite beds (R-4656 and R-4657, Plate 3). Plagioclase is predominant over potassic feldspar throughout the unit and the total feldspar content is higher in the gneiss than in the feldspathic quartzites. Biotite composes 10 to 20 percent of the gneiss, and muscovite from a trace to 10 percent and up to 99 percent in the interlayered mica schists. Tourmaline, zircon, sphene, rutile, epidote, and opaques occur in minor amounts.

Garnet-Hornblende Schist and Garnetiferous Amphibolite

The garnet-hornblende schist and garnetiferous amphibolite is present as massive layers in the mica schist and gneiss units. It is dark green to black and spotted with orange to red garnets, breaks into regular flaggy slabs, and decomposes to a punky, ocherous saprolite and red, clayey soil. Gneissic banding is present in some specimens (R-4666, Plate 3), but the rock is generally schistose (R-4669, Plate 3) and has a silky sheen on freshly cleaved surfaces because of many parallel hornblende prisms. In thin section the hornblende has a bluish-green to yellowish-green pleochroism and constitutes from 20 to 75 percent of the rock. The prisms range from 0.2-1.0 mm in length, and together with smaller elongate quartz blasts, form a schistose interlocking matrix. The quartz content of the rock ranges from less than 10 percent to almost 50 percent, averaging about 15 percent; plagioclase from 0 to 20 percent, either as interlocking grains in the matrix or in distinct quartz-feldspar-epidote bands; and garnet from 5 to 15 percent, as poikilitic porphyroblasts up to 1 cm diameter. It is intensely fractured and contains sigmoidal trains of inclusions and marginal alterations to chlorite, possibly a retrograde mineral.

PRECAMBRIAN (?) ROCKS

ALTERED METAPYROXENITE AND TALC SCHIST

Pod-shaped and stratiform bodies of altered ultramafic rocks occur in the Bassett, Fork Mountain, and Rich Acres formations, and in the gneiss and mica schist units. These bodies have two predominant lithologies: light-gray to light-green schist and dark, grayish-green, granular rock. Both lithologies may occur in the same body and intergrade with each other.

A tan-weathering, light-green, lustrous rock (R-4161, Plate 3) is typical of the schist. A thin section of the rock contains approximately 65 percent cummingtonite up to 1 mm in length. Folia of talc and chlorite up to 0.3 mm diameter occur interleaved with the amphibole. Talc composes 20 percent of the schist, chlorite 10 percent, and opaques about 5 percent.

The granular rock (R-4659, Plate 1) contains about 60 percent tremolite, 25 percent chlorite, and 10 percent talc. No igneous texture is present in the thin section, although traces of colorless pyroxene, possibly of igneous origin, were noted. The granular ultramafic rocks generally contain olivine (probably a relict igneous mineral). A sample (R-4660, Plate 1) consists of approximately 40 percent fractured olivine grains up to 3.5 mm diameter. It is veined by serpentine and magnetite and is enclosed by fibrous and decussate masses of tremolite, chlorite, and talc. A sample from the Price quadrangle (R-4664, Plate 3) contains approximately 60 percent subhedral olivine grains; it also contains fine intersecting veins of yellow-green serpentine and carbonate. Tremolite is present in equal amounts and is intergrown with chlorite in the matrix and some is pseudomorphous after pyroxene.

ALASKITE

Medium- to coarse-grained alaskitic dikes and sills intrude Precambrian metamorphic and igneous rocks southeast of the Bowens Creek fault. The alaskites are concentrated in two areas; the Fork Mountain-Chestnut Mountain mica district and the Ridgeway mica district (Brown, 1962, p. 118-134, p. 151-163). Deuser and Herzog (1962, p. 200) analyzed Rb-Sr ratios in muscovite from a pegmatite of the Ridgeway mica district (Knight mine, Rockingham County, North Carolina), which indicates an age of 321± 17 million years. As most of the alaskites and pegmatites of the district are sheared and partially recrystallized, it is thought that this date represents shearing and recrystallization during movement along the Ridgeway fault and probably the later stages of faulting.

Along Fork Mountain and on Chestnut Mountain, pegmatite dikes, sills, and stringers have intruded the schist of the Fork Mountain formation generally parallel to the foliation (Plate 1). Near the contacts with the pegmatites the schist may contain concentrations of tourmaline, porphyroblastic muscovite, and quartz-sillimanite stringers. The dikes are deeply weathered to white kaolinitic saprolite. Relatively unweathered outcrops are massive, light gray to white and consist of medium- to coarse-grained aggregates of plagioclase, perthite, quartz, and greenish books of muscovite with accessory garnet, tourmaline, biotite, and beryl (Griffitts, Jahns, and Lemke, 1953, p. 191).

Other alaskite and pegmatites occur in the Fork Mountain and Bassett formations at several places. They are variable in texture, but show little variation in mineralogy. A leuco-quartz diorite intrusive into the gneiss of the Bassett formation occurs along State Road 108 (R-4191, Plate 1). It contains approximately 35 percent plagioclase, 35 percent quartz, 10 percent potassic feldspar (microcline and perthite), 7 percent biotite, 7 percent muscovite, 5 percent epidote, and a trace of zircon. Pegmatitic dikes that cut the aluminous schists of the Fork Mountain formation contain a high percentage of muscovite and may also contain aluminosilicate minerals. A thin section from R-4673 from one of these bodies (Plate 3) has a coarse-grained cataclastic texture and contains approximately 50 percent muscovite and 40 percent quartz. Kyanite occurs as anhedral blasts within the muscovite.

Leuco-granitic rocks in the Ridgeway area (Plates 2 and 3) consist primarily of sills, stringers, and concordant pods of light gray, foliated quartz monzonite to quartz diorite (Griffitts, Jahns, and Lemke, 1953, p. 144). Contacts are generally sharp and at many localities the intrusions are so interlayered with the country rock as to form injection gneisses. The intrusive rocks are intensely deformed and have cataclastic textures. A sample from one of the large sheets in the gneiss along Smith River (R-4672, Plate 3) has partly crushed feldspar augen up to 4 cm diameter in a finer grained, granular groundmass. A thin section from this locality contains approximately 40 percent potassic feldspar, 30 percent plagioclase, 20 percent quartz, 10 percent muscovite, and a trace of epidote. Rose garnet dodecahedra, 1-2 mm diameter, are sparsely scattered throughout the rock. A sample from a dike-like stringer cutting amphibolite of the Bassett formation (R-4671, Plate 3) has an equally cataclastic texture. The feldspar augen are marginally deformed and altered. Plagioclase phenocrysts, up to 4 cm diameter, make up about 20 percent of the rock; potassic feldspar, primarily perthite, constitutes about 40 percent and occurs in fine irregular grains with quartz and muscovite. Trace amounts of garnet are also present.

Textures and mineralogy are essentially the same in the alaskites and pegmatites that cut the rocks of the Smith River allochthon and those that cut the rocks of the Sauratown Mountains anticlinorium. Because they occur on both sides of the Ridgeway fault, the sheared dikes and sills may represent several generations of intrusions, many of which must be either synchronous with faulting or post-date the emplacement of the Smith River allochthon.

TRIASSIC SYSTEM

DIABASE DIKES

Triassic diabase dikes have intruded rocks in the area and generally trend either N.-N.10°W. or N.20-30°W. Fresh outcrops are rare, but even where deeply weathered, the dikes can be mapped by characteristic rusty, rounded boulders and deep, reddish- to dark-brown clayey soils.

They show little variation in mineral composition but have much variation in texture, ranging from basalt to gabbro. A sample from a very thin dike (R-4689, Plate 3) is typical of the basalt. It consists of relatively elongate laths of plagioclase among stubby augite anhedra, both less than 1 mm diameter. The rock has a more felsic composition than most of the diabases and contains significant amounts of micro-

Figure 23. Photomicrograph of diabase (R-4694) from a dike about one mile east of Dyers Store; cross-polarized light.

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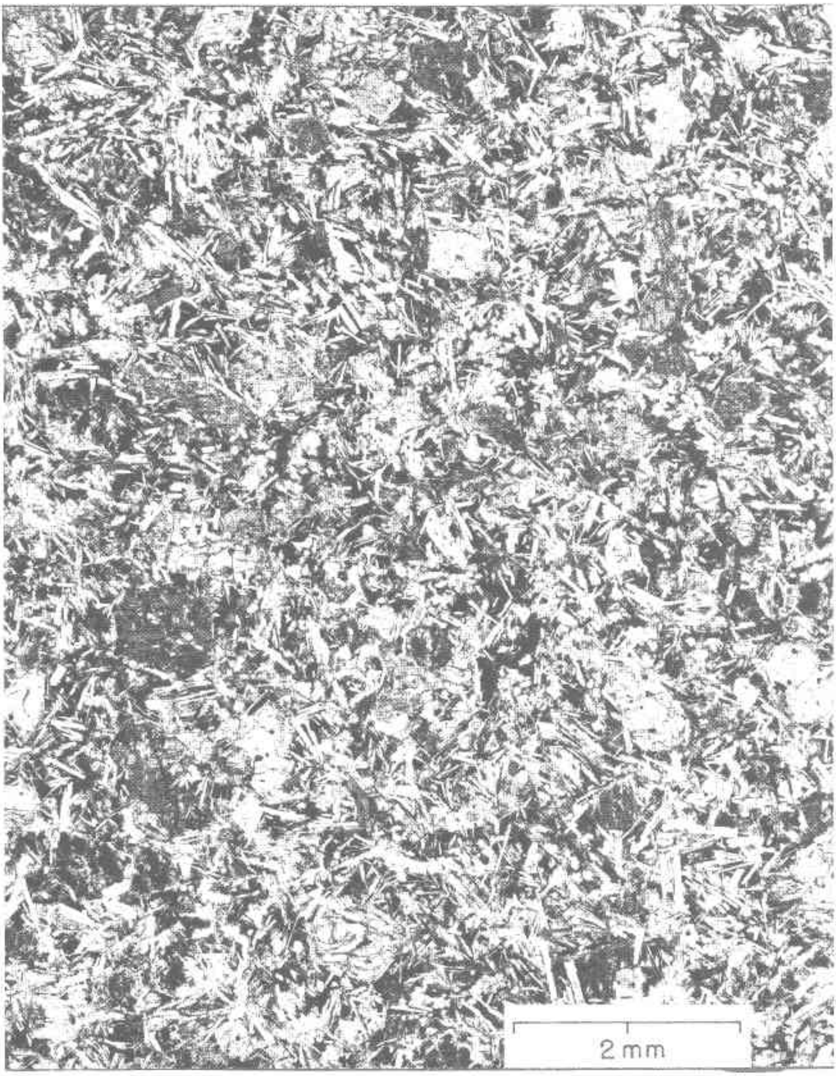


Figure 23. Photomicrograph of diabase (R-4694) from a dike about one mile east of Dyers Store; cross-polarized light.

pegmatite and myrmekite in its interstices. Typical olivine diabase (R-4694, Figure 23, Plate 1) is medium grained and has subophitic texture. The rock is composed of about 50 percent plagioclase, 40 percent augite, and 10 percent olivine.

A sample from one of the thicker dikes (R-4693, Plate 3) is a typical olivine gabbro. It contains approximately 40 percent plagioclase, 40 percent augite, 10 percent olivine, 5 percent hypersthene, and 2 percent biotite. The essential minerals are generally coarse grained; plagioclase occurs as zoned laths that average 1.2 mm in length; augite has formed anhedral, poikilitic aggregates that average 2.5 mm across and olivine occurs in doubly terminated, tabular crystals up to 1.5 mm in length. Both hypersthene and biotite are intergrown with the other mafic minerals. Biotite also occurs as vermicular intergrowths into plagioclase, and is associated with magnetite, along plagioclase-pyroxene contacts.

Pale-green, fibrous serpentine, and minute flecks of talc also occur as alterations of the mafic minerals in the olivine gabbro. Partial replacement of plagioclase by sericite (paragonite?) in both the basalt and diabase, replacement of biotite by chlorite in the basalt, and replacement of the mafic constituents by serpentine in the olivine diabase, indicate that these dikes were subjected to deuteric alteration.

QUATERNARY SYSTEM

COLLUVIUM

Deep-red colluvium is present on the flanks of hills, especially near the headwaters of some small streams. It consists of unsorted angular rock fragments, fine sand, silt, and clay. The matrix, however, closely resembles saprolite; thus, colluvium may also be present in areas of lower relief. The slopes of the higher mountains and ridges are mantled by accumulations of angular boulders and blocks.

ALLUVIAL-TERRACE DEPOSITS

Thin remnants of fluvial sediments are generally preserved as terraces on slopes and flat-topped hills. They are most abundant and best exposed along incised meanders of the Smith River, especially in the areas underlain by the Rich Acres formation. Terraces along the river south of Martinsville seem to occur at several different levels (Plates 2 and 3).

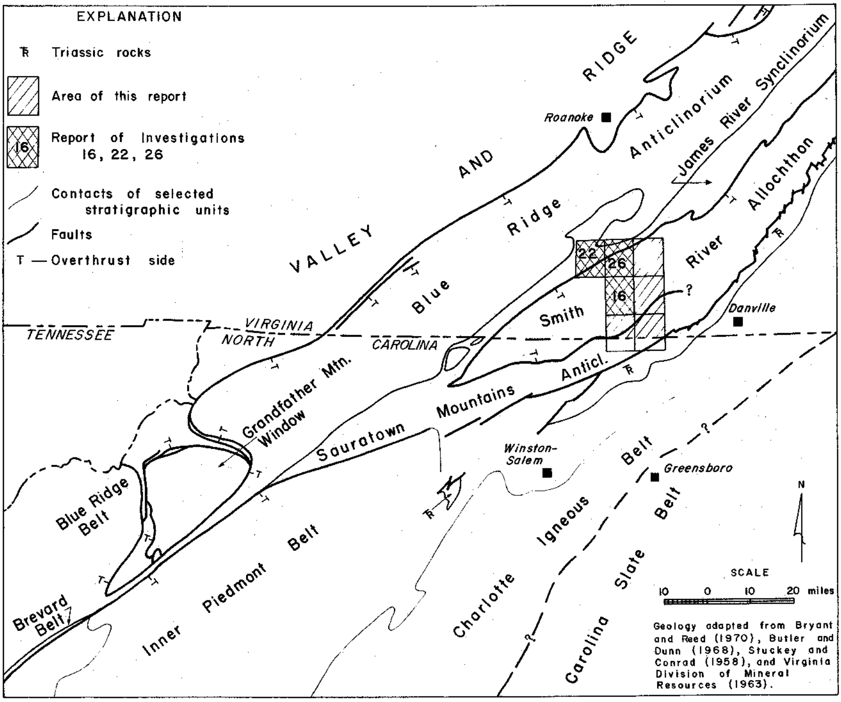
The terrace deposits that occur at the highest elevations consist primarily of rounded cobbles and pebbles of quartz generally lying on saprolite. Some have a dark red matrix of sand, silt, and iron oxide. The pebbles and cobbles have etched surfaces, especially upper surfaces, because of continued exposure to weathering. White gravels overlain by white kaolinitic clay form terraces and compose valley fill in the headwaters of smaller streams; some of the streams are eroding headward into these deposits. Additionally, a layer of mottled red and gray clay occurs at the base of a large terrace across the Smith River from Fontaine; gray silt beds occur in lower terrace levels south of Old Liberty; and white sand and sandy clay layers are common in high terrace levels above Smith River in the northern part of the Spray quadrangle (Plate 3).

ALLUVIUM

The valley floors of many of the streams are partially to totally covered with alluvial deposits (Plates 1-3). The base of these deposits is composed of poorly sorted pebbles and gravels intermixed with sand and clay. The alluvium may have a thick gray clay or silty clay near the base. Bedded brown sand, silt with pebbly layers, and clay beds overlie the basal layers. The upper part of these deposits is generally composed of organic silts and silty-clayey sands, overlain by a shallow soil zone rich in organic material.

STRUCTURE

The major geologic structures in the area of this report are the southeastern limb of the northeastward-trending Cooper Creek anticline, a fold in the Blue Ridge anticlinorium; the Bowens Creek fault, a northeastward-trending, southeastward-dipping thrust fault along which the direction of movement of the upper plate was to the northwest; the Smith River allochthon, a synformal rootless mass; the Ridgeway fault, a northeastward-trending, northwestward-dipping thrust fault along which movement of the upper plate was to the northwest; and the Sauratown Mountains anticlinorium, an upwarp with an older Precambrian core surrounded by younger Precambrian metasedimentary rocks (Plate 4, Figure 24). The interpretation of these structures is based on the geometric configuration of stratigraphic units and the attitudes of foliations that include fracture cleavage, schistosity, compositional banding, and bedding. Schistosity is the predominant planar structure of the micaceous paraschists and for the most part is equivalent to gneissic banding in quartzo-feldspathic rocks. Gneissic banding is generally parallel to bedding as indicated by interlayered quartzite beds. Fracture cleavage is best developed along the Bowens Creek fault and less so along the Ridgeway fault.



Geology adapted from Bryant and Reed (1970), Butler and Dunn (1968), Stuckey and Conrad (1958), and Virginia Division of Mineral Resources (1963).

Figure 24. Generalized regional map showing the major geologic structures in the Piedmont and Blue Ridge provinces of southwestern Virginia and northwestern North Carolina.

FOLDS

BLUE RIDGE ANTICLINORIUM

The major structure in the Blue Ridge anticlinorium in the area is the Cooper Creek anticline, which was named by Conley and Henika (1970). The southeastern limb of this structure is present across the northwestern part of the Snow Creek quadrangle (Plate 1). The Moneta gneiss is exposed in its core and the overlying Lynchburg dips to the southeast off its southeastern limb. Northeastward-trending folds, considered to be parasitic structures on the limb of the anticline, have been observed in the amphibolite interlayers in the Moneta gneiss along State Road 718. The axial planes of these structures are either vertical or they are inclined to the southeast. Also, several folds plunging gently to the northwest, almost at right angles to the axis of the major structure, are present in the same area; they were probably formed by compressional bending along the main structure, normal to its axial plane.

Foliations in the Lynchburg generally have a consistent dip southeastward off the Cooper Creek anticline (Plate 1, Section A-A′); however, several similar isoclinal folds (Turner and Weiss, 1963, p. 116) were seen in the basal quartzites and metagraywackes. These folds are also overturned to the northwest and their axial planes have a dip to the southeast at steep angles.

SMITH RIVER ALLOCHTHON

The Smith River allochton is here named for rocks contained in a structure that lies between the southeastward-dipping Bowens Creek fault and the northwestward-dipping Ridgeway fault. It is located between the Blue Ridge and Sauratown Mountains anticlinoria (Figure 24). The synclinal structure that contains the allochthon probably lies along the axial trace of the James River synclinorium of Brown (1953, 1958). Its southwestern closure in North Carolina was established by Butler and Dunn (1968, p. 39).

The internal structure of the allochthon is one of complex polyphase folds, some of which predate its emplacement. Early sets of folds are characterically isoclinal and, near the center of the synclinorium, have subhorizontal axial planes; a later set of folds generally consists of overturned antiforms and synforms.

The major structure, a broad open synform, was produced during a later phase of deformation. The central part of the structure contains the Fork Mountain formation that can be traced from Turkeycock Mountain in the Snow Creek quadrangle to the Virginia-North Carolina boundary in the Price quadrangle (Plates 1-4). Near the boundary, the formation is terminated because of the northeastward plunge and downward closure of the synform. The Bassett formation crops out along the northwestern flank of the fold, and can be traced around the nose and along the southeastern flank of the structure (Plates 2-4). It is limited areally along the nose and southeastern flank because it was intruded by igneous rocks and is complicated by omission of the unit along the northwestward-dipping Ridgeway fault (Plate 3, Sections A-A′, C-C′, D-D′, and E-E′).

Diagrammatic cross sections in Figure 25 show the generalized structural configuration of the allochthon. Northwest of the main synform (Plates 1-3, Figure 25) the structure that contains the Bassett formation in its center is interpreted to be an early formed, complex antiform that has been refolded around the later formed, main synform. One limb of this antiform is delineated by the northwestern outcrop belt of Fork Mountain formation that has been traced from Fork Mountain in the Snow Creek quadrangle to beyond the southwestern

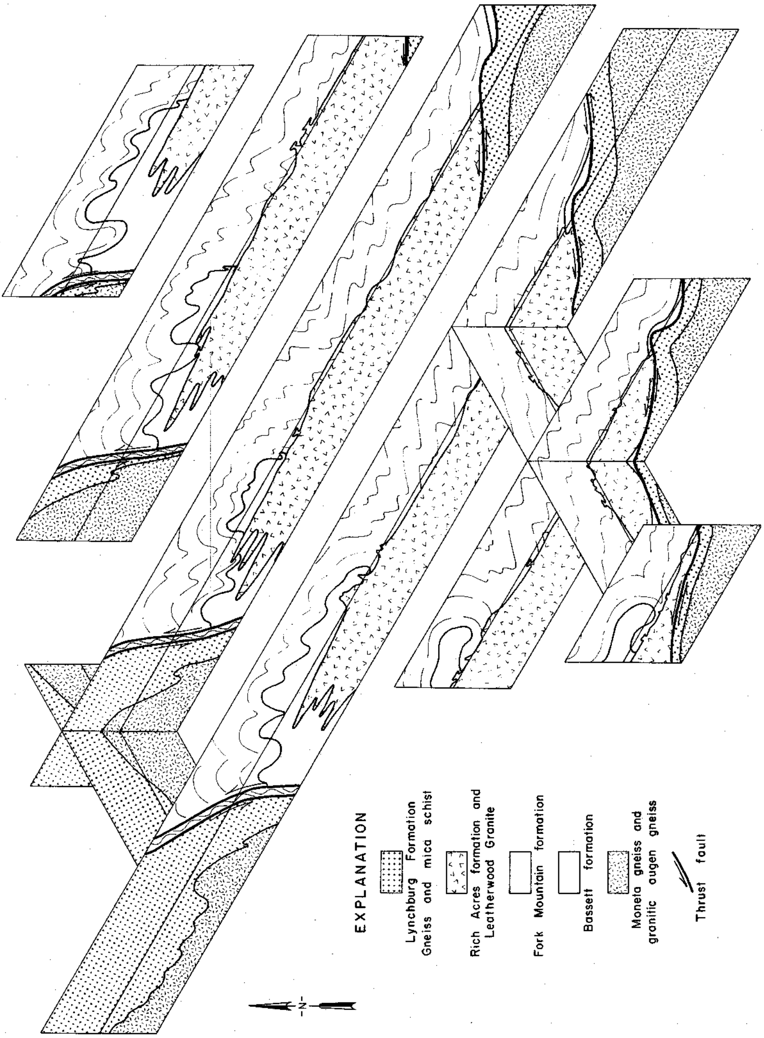


Figure 25. Diagrammatic cross sections of the Smith River allochton in the Philpott Reservoir, Bassett, Snow Creek, Martinsville West, Martinsville East, Price, and Spray quadrangles (horizontal center line along the sections represents present surface).

part of the Philpott Reservoir quadrangle (Plates 1, 4) and the other limb of the fold by the second band of Fork Mountain formation that lies to the southeast of the first.

In the southwestern part of the Bassett quadrangle and the northern part of the Martinsville West quadrangle adjacent to the study area

(Plate 4), the Fork Mountain formation southeast of the outcrop band of Bassett formation has a northwesterly dip, whereas the formation northwest of the band of Bassett has a southeasterly dip. In this area the antiform closes both to the northwest and to the southeast, having the configuration of a box fold that is depressed into a synform on its central platform. The existence of this synform was first recognized by Conley and Toewe (1968) and it was named by Henika (1970) for Reed Creek in the Bassett quadrangle. The northwestward-closing hinge is parallel to the major synformal axis and seems to continue in a southeasterly direction, whereas the southeastward-closing hinge can be traced around the major synform.

In the Snow Creek quadrangle, a second antiformal structure containing Bassett formation lies to the northwest of the first and is located between the two forks of Fork Mountain (Plate 1). Antiforms and synforms involving the Fork Mountain and Bassett formations northwest of the major open synform are parallel to this major structure and belong to the later northeastward-trending fold system and modify the earlier overturned isoclinal folds (Plate 4, Figure 25).

SAURATOWN MOUNTAINS ANTICLINORIUM

The Sauratown Mountains anticlinorium is located in the southern and southeastern parts of the area. The core of the structure is composed of granitic augen gneiss which is the local basement to the overlying northward- and northwestward-dipping gneiss and mica schist unit. These overlying metasedimentary rocks have been deformed into a series of folds that are either open or overturned to the northwest, which are generally disharmonic with, and not penetrative into, the underlying basement, indicating a possible dêcollement. In contrast, minor folds shown by a consistent northwestward-trending lineation (Plate 1) pervade both the basement and the metasediments. Three major folds are recognized (Plates 2 and 3); they consist of a northward-trending anticlinal cross-warp in the southeastern part of the Martinsville East and northeastern part of the Spray quadrangles that separates two synclinal structures having cores of the upper gneiss unit. Only part of the eastern syncline is contained within the area, but most of the southwestern structure is present. This southwestern syncline shows polyphase deformation; it apparently developed as a northeasterly-trending structure and after formation was refolded around the nose of a synformal structure located just south of Ridgeway that lay to the northwest and affected both the Sauratown Mountains anticlinorium and the Smith River allochthon (Plate 3). This later deformation also warped the synform into a series of smaller folds. It is obvious that some folding occurred either at the end of, or after emplacement of the Smith River allochthon, because both the rocks of the allochthon and the rocks of the Sauratown Mountains anticlinorium have been harmonically folded together.

FAULTS

BOWENS CREEK FAULT

The Bowens Creek fault, named by Conley and Henika (1970, p. 34) in the Philpott Reservoir quadrangle has been traced in a northeasterly direction across the Bassett (Henika, 1971) and Snow Creek quadrangles. In the Snow Creek, as in the areas previously mapped, the fault is marked by a band of tectonic schists and phyllonites that ranges from 2000 to 3000 feet wide and has a dip to the southeast at angles from 55 degrees to vertical. This shear zone was produced by crushing of both the overlying Fork Mountain formation and the underlying Lynchburg Formation, but was primarily from the Lynchburg, as indicated by graphitic schists and phyllonites which occur throughout the bottom two-thirds of the zone. The rocks of the shear zone are cut by a pervasive fracture cleavage that is oriented generally more east of north than the foliation and has a gentle dip to the south. Just below the contact with the Fork Mountain formation, sheared mica schists containing satiny mica porphyroblasts and sheared and deformed chloritoid porphyroblasts derived from the Fork Mountain are prevalent.

In the extreme northern part of the Snow Creek quadrangle, a chlorite-chloritoid phyllite or phyllonite occurs just below a zone containing the sheared chloritoid porphyroblasts. Whether this rock is a phyllite or a phyllonite could not be determined; the rock has a crushed aspect, but the chloritoid porphyroblasts are oriented parallel to foliation and are not tectonically deformed (Figure 26). Because of the resemblance to the Candler Formation, which according to Brown (1958) overlies the Lynchburg, this unit might be a tectonic slice of Evington Group brought up along the fault, although the Lynchburg also contains chlorite-rich zones in this area.

Boudinage, foliations, and mineral streaks all indicate that the structure is a thrust fault and movement of the upper plate was northwestward. Movement along this fault has brought rocks of the Smith River allochthon, the over-riding block, into juxtaposition with rocks of the Blue Ridge anticlinorium.

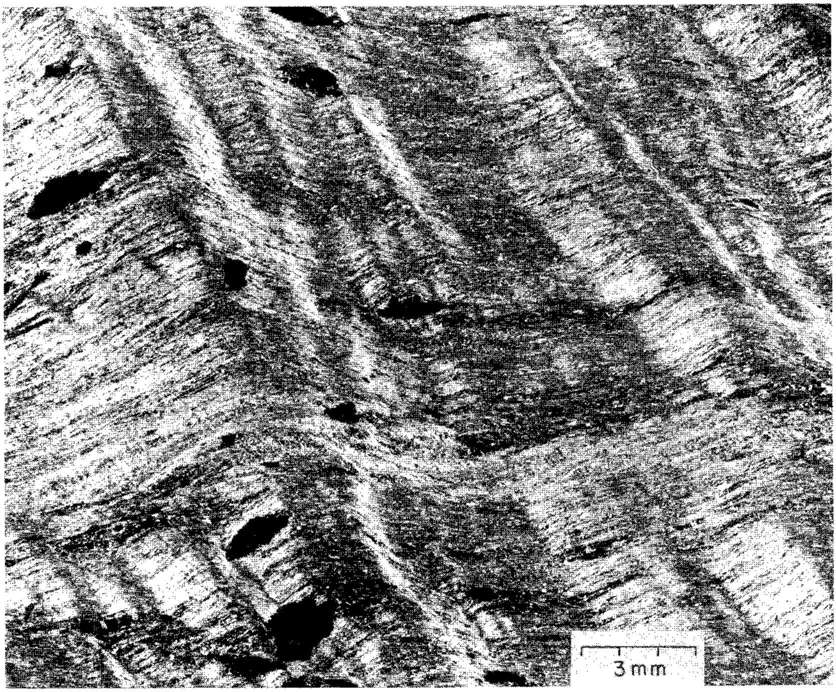
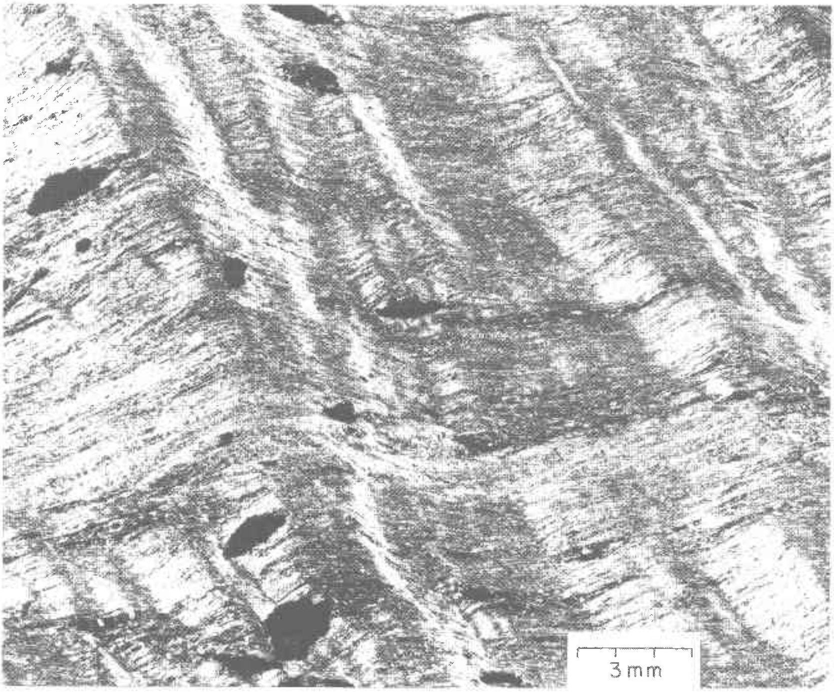


Figure 26. Photomicrograph of phyllonite ? (R-4728) from the Bowens Creek fault zone along the northwestern side of Fork Mountain, Snow Creek quadrangle; cross-polarized light.

RIDGEWAY FAULT

The Ridgeway fault is here named for an east-northeastward-trending fault that occurs at Ridgeway (Plate 3). It has a dip to the north and northwest from 45 to 70 degrees and has been traced through the southeastern part of the Martinsville East, the central part of the Spray, and the southern part of the Price quadrangles (Plates 2, 3). As this fault is on the eastern perimeter of the allochthon and has a dip to the northwest, it is presumed that the two border faults, the Bowens Creek and Ridgeway, either intersect or form a common plane under the allochthon. However, until such time as they are physically traced into each other, this correlation should remain tentative.

The Ridgeway fault, unlike the Bowens Creek fault, does not have a separate mappable zone of phyllonite and tectonic schist, although sheared rocks may occur in a zone several hundred feet wide on either side of the fault. This shear zone has been intruded by alaskite and mica pegmatite and in some places they have obliterated the fault



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MINOR FAULT

An east-northeastward-trending vertical minor fault has been traced for about 500 feet along the stream bed of a tributary to the Martinsville Reservoir in the extreme southwestern part of the Snow Creek quadrangle (Plate 1). It is downthrown on its southeastern side and has developed a zone of gouge and breccia as much as four feet wide along much of its trace.

AEROMAGNETIC SURVEY

A composite map (Plate 5) shows aeromagnetic contours superimposed on the generalized geology of the four quadrangles of this report and the three quadrangles previously mapped in the Martinsville area (Conley and Toewe, 1968; Conley and Henika, 1970; and Henika, 1971). The magnetic contours were adapted from two surveys (Virginia Division of Mineral Resources, 1966, 1969 a, b, c) that were computed from different magnetic datums. The survey to the southwest used a magnetic datum approximately 2600 gammas less than the survey to the northeast. The magnetic contours are generally parallel to the trend of the Blue Ridge anticlinorium, the Smith River allochthon, and the Sauratown Mountains anticlinorium. The surface delineated by magnetic contours over the two anticlinoria is characterized by low relief. It contrasts markedly with the surface of high relief developed over the Smith River allochthon.

Within the allochthon, the pattern of magnetic contours developed over the Bassett formation is characterized by linear areas of closure. Localized highs and lows seem to be related to the susceptibility contrast between gneiss and amphibolite. Linear magnetic contours are subparallel to the outcrop patterns of the amphibolite bodies.

Magnetic contours over much of the Fork Mountain formation have a characteristic pattern produced by numerous high amplitude, positive magnetic anomalies. The anomalies in the northeast, north-central, and southwestern parts of the structure seem to correspond to high concentrations of magnetite in the hornfels zone over the Leatherwood Granite and Rich Acres formation. There is generally a positive magnetic gradient from the igneous rocks across the contact with the Fork Mountain formation.

The Fork Mountain formation, in a northwestern outcrop belt in the Philpott Reservoir and Bassett quadrangles, has a much more subdued magnetic pattern than that in the Snow Creek, Martinsville East, Martinsville West, Spray, and Price quadrangles. This could be due to the absence of contact metamorphism as it is some distance away from exposed igneous rocks. Magnetic contours over the igneous rocks delineate a surface of low relief with several closed depressions. The few closed positive areas over the Rich Acres formation seem to correspond to ultramafic rocks.

The magnetic data seems to support the interpretation of a fault contact between the Smith River allochthon and the Sauratown Mountains anticlinorium. This is indicated by the fact that the Fork Mountain formation everywhere in the allochthon shows high intensity positive anomalies. These are especially well developed in areas where it has been affected by contact metamorphism from the Leatherwood and Rich Acres. However, the gneiss and mica schist of the Sauratown Mountains anticlinorium shows low intensity, and no magnetic anomalies characteristic of this hornfels zone, even in areas in direct contact with the gabbro of the Rich Acres formation. Thus, the contact between the gabbro and the gneiss-mica schist unit is not an intrusive contact; if it were, it would be separated from the Rich Acres by a metamorphic zone showing a positive magnetic gradient.

GEOLOGIC HISTORY

BLUE RIDGE ANTICLINORIUM

The Moneta paragneiss is the oldest known rock in the Blue Ridge anticlinorium. It is composed of mica gneiss with interbeds of amphibolites that probably represent quartzo-feldspathic sediments with either interlayered impure dolomite or mafic volcanic rock. West of the study area it contains gneissic marbles (Conley and Henika, 1970, p. 10-13) and to the north and northwest, the unit was intruded by migmatites and granites that have been dated at approximately one billion years old (Brown, 1970, p. 337). These rocks were probably intruded during the orogenic event in which the Moneta was folded and metamorphosed at almandine-amphibolite grade to coarse biotite-muscovite gneiss and amphibolite. After regional metamorphism, uplift and erosion exposed it at the surface.

The Lynchburg Formation was deposited unconformably on the Moneta in late Precambrian time. Brown (1970, p. 338) considered the Lynchburg to be a deep-water deposit that is suggestive of flyschtype deposits. The metamorphosed sequence of lithic conglomerates, conglomerates, and graywackes with interlayered pelites, graphitic schists, and basalts (Conley and Henika, 1970, p. 14-23) are suggestive of such a stratigraphic sequence deposited during the development of an oceanic trench (Dewey and Bird, 1970, p. 2638-39). Following deposition, the Lynchburg was metamorphosed at greenschist facies, chlorite grade was generally realized, and in some areas biotite was formed.

If the Catoctin, the base of which was dated by Rankin and others (1969) at 820 million years old, is interbedded with the top of the Lynchburg as thought by Brown (1958), then the metamorphism had to occur after the Catoctin was deposited, indicating a late Precambrian or early Paleozoic orogeny. The oldest of the K-Ar dates reported by Furcron (1969) on micas from the Lynchburg is 425 million years. This is a minimum date for this event and probably represents a time of uplift and erosion after the metamorphic peak, when the rocks had sufficiently cooled that micas became a closed system to potassium and argon.

SAURATOWN MOUNTAINS ANTICLINORIUM

The granitic augen gneiss, the oldest unit in the Sauratown Mountains anticlinorium, was dated by Rankin (1971, p. 343) as 1192 million years old. The gneiss cannot be assigned to either an igneous or sedimentary origin, because of high-rank metamorphism. After this high-rank metamorphism had occurred, erosion exposed the granitic augen gneiss and sediments were deposited on it. These originally were probably quartzo-feldspathic sediments, shales, and either volcanic rocks or impure dolomites that have been metamorphosed to gneiss and mica schist with interlayered amphibolite. If Butler and Dunn (1968, Figure 8) are correct, these rocks are traceable into the Lynchburg Formation as shown on the geologic map of Virginia (Virginia Division of Mineral Resources, 1963). The lithologic similarities between these rocks and the Lynchburg indicates that they were probably layed down in an eugeosynclinal environment similar to that suggested by Brown (1970) for the known Lynchburg. After deposition, the sediments were metamorphosed at staurolite-almandine subfacies of the almandine-amphibolite facies (Barrovian-type metamorphism) as indicated by the mineral assemblage of kyanite, muscovite, almandine, and staurolite (Winkler, 1967, p. 107). If these metasedimentary rocks are equivalent to the known Lynchburg to the west, then they were metamorphosed at the same time as the Lynchburg itself, and metamorphic grade must have increased in a southeasterly direction from greenschist facies in the Blue Ridge anticlinorium to almandine-amphibolite facies in the Sauratown Mountains anticlinorium.

SMITH RIVER ALLOCHTHON

The oldest rocks in the Smith River allochthon are the Bassett and Fork Mountain formations. In the present structural setting, the Bassett underlies the Fork Mountain. This is the preferred stratigraphic position for these units, and fits the best structural model for the area that can at this time be deduced (Figure 25), that is, a complexely folded sheet. It could also be interpreted as the upper limb of a detached recumbent fold nappe with an almost horizontal fold axis overturned to the northwest. In such a case the stratigraphic position would remain the same. Alternately, the structure could be the bottom limb of a recumbent fold overturned to the southeast; if so, the stratigraphic sequence would be upside down.

The Bassett formation was probably derived by metamorphism of quartzo-feldspathic sediments. The amphibolite beds at or near the top of the formation are continuous over wide areas and are thought to be stratigraphic horizon markers. These amphibolites were probably either mafic volcanic rocks, tuffs and/or flows, or impure dolomite beds. The Fork Mountain formation, composed of pelitic, high-alumina schist with minor amounts of quartzite and calc-quartzite, probably was a sequence of high-alumina shales and interbedded sandstones and calcareous sandstones.

These sedimentary rocks were regionally metamorphosed and folded in an orogenic event that occurred prior to the 1020 million year-old intrusion of the Rich Acres formation and Leatherwood Granite. This metamorphism was of the Barrovian type at almandine-amphibolite facies (Winkler, 1967). Along the northwestern border of the allochthon, the rocks reached staurolite grade, whereas in the central and southern parts of the area, they reached sillimanite grade. During this time they were warped into a series of elongate, generally overturned to recumbent folds. The elongate folds were refolded into a series of low amplitude, open to overturned, structures. The final product of this polyphase folding was development of a complexly folded antiformal structure containing Bassett formation in its core that completely wraps around a shallow synform having a core of Fork Mountain formation (Figure 25).

Following the prograde event the rocks were retrograded to greenschist facies. Probably during this retrograde event they were crushed and recrystallized, partially obliterating metamorphic textures formed during regional metamorphism. It is unknown whether this retrograde metamorphism was produced by hydration during the waning phase of the regional metamorphism or by fluids given off during intrusion of the Leatherwood Granite and Rich Acres formation.

Either following, or contemporaneous with retrograde metamorphism, the Leatherwood Granite and Rich Acres formation were emplaced as a body with a semi-concordant upper contact. The body is composed of several lithologies that are attributed to separate injections of varying compositions, similar to the multiple injections proposed by Irvine and Smith (1967, p. 48-49) for the Muskox intrusion. The oldest rock in this sequence is a fine-grained gabbro. The Leatherwood Granite cuts the gabbro as generally narrow dikes and has accumulated as irregular sheets at the top of the gabbro. The porphyritic Leatherwood may grade into alaskite and in turn be cut by pegmatite dikes. Diorite occurs as thin discordant masses that vein the gabbro and contains inclusions of Leatherwood northwest of Nantes Mountain (Plate 2). Age relationships between the norite and the other rocks are not clear. The norite does show less shearing and alteration than either the gabbro or the Leatherwood.

During emplacement of the Leatherwood Granite and Rich Acres formation, they developed a thermal aureole that caused contact metamorphism in the overlying metasedimentary rocks. The pelitic rocks of the Fork Mountain formation were more obviously affected by conversion of the mica schist to garnetiferous biotite gneiss. In contrast, the major affect on the Bassett formation was development of anatectic melts near the igneous mass. The basal part of the garnetiferous biotite gneiss, like the Bassett formation, contains anatectic zones and is cut by pegmatites. Above this zone the banded gneiss grades into mica hornfels and finally into recognizable mica schist. Metamorphic grade can be judged by the fact that sillimanite is developed in the gneiss and overlying mica schist. Away from the igneous body, kyanite and staurolite replace sillimanite and further away, are replaced by chloritoid. These new minerals tended to nucleate and grow in the sites of sericite pseudomorphs after aluminosilicate minerals formed during regional metamorphism. An isograd delineating the northwestward extent of the occurrence of chloritoid (prograde contact metamorphism) has been traced across the Bassett quadrangle (Henika, 1971, p. 23, 25, and Figure 7, p. 26). The isograd intersects the Bowens Creek fault approximately at the western boundary of the Snow Creek quadrangle and chloritoid occurs in the Fork Mountain formation to the fault zone along its trace northeastward to the eastern border of the Snow Creek quadrangle.

The presence of anatectic melts near the contacts with the Leatherwood and Rich Acres and the presence of sillimanite in the reaction K-feldspar + Al_2SiO_5 = muscovite + quartz indicate that temperatures of about 700° C and pressures of about 2.5 kb were realized in the aureole (Winkler, 1967, Figure 16, p. 73). Such pressures would normally be encountered at depths ranging from 8 to 9 km (Turner, 1968, Figure 8-8a, p. 377) which indicates an approximate depth of emplacement of the Leatherwood and Rich Acres igneous body.

Discordant ages obtained from zircon samples that were collected from the Leatherwood Granite and Rich Acres indicate that they were intruded about 1020 million years ago. Therefore, the igneous rocks that intrude the Moneta gneiss in the core of the Blue Ridge anticlinorium, the gneiss in the core of the Sauratown Mountains anticlinorium and the Leatherwood and Rich Acres all date from 1000 to 1192 million years old. These are all in the range of dates that occur throughout the Southern Appalachians and correspond closely with the 1000 million to 1400 million year old dates of the Grenville orogeny (Engel, 1963, p. 151).

Following the intrusion of the Leatherwood and Rich Acres, the rocks that comprise the Smith River allochthon were thrust over the rocks of the Sauratown Mountains anticlinorium and against the rocks of the Blue Ridge anticlinorium. The Evington Group is exposed northeastward along the Bowens Creek fault; hence, these rocks might be buried under the allochthon.

Rocks that comprise the allochthon resemble the rocks of the inner Piedmont belt of the Carolinas (Conley and Toewe, 1968). A complicating factor is that the inner Piedmont belt in North Carolina is bent sharply eastward just south of the Virginia-North Carolina boundary (personal communication, G. H. Espenshade, 1971). The possibility exists that the rocks of the allochthon might extend around the northern nose and eastern flank of the Sauratown Mountains anticlinorium and connect with the rocks of the inner Piedmont belt (Figure 24).

The northwestern border of the allochton is marked by a pronounced mappable shear zone in which sericitic cataclastic schist and phyllonite are developed. The rocks bordering the Ridgeway fault on the southeastern side of the allochthon are sheared, but are not so deformed that they are mappable as a separate unit. Sheared pegmatites occur throughout the Ridgeway fault zone. They were probably emplaced during thrusting and the hydrothermal solutions from which they were deposited could have aided in altering the mafic rocks of the Rich Acres formation and the mica schist and gneiss of the Sauratown Mountains anticlinorium along the fault.

Rb-Sr ages of 321 million years from micas of the pegmatites in the Ridgeway mica district (Deuser and Herzog, 1962, p. 2000) indicate a minimum age for the thrusting. This date is in agreement with 300 million year ages (K-Ar) for movement along the Brevard fault (Wampler, Neathery, and Bentley, 1971, p. 356).

After thrusting, but possibly during the same orogenic event, the Blue Ridge and Sauratown Mountains anticlinoria were domed upward in a manner possibly similar to the method of development of mantled gneiss domes as proposed by Fletcher (1972, p. 198). At the same time the plane of the Ridgeway fault was warped into a series of northeasterly-trending folds that produced indentations along the fault trace, especially in the Price quadrangle (Plate 3).

Following deformation and uplift, overlying rocks were removed by erosion. This erosion exposed at the surface the rocks that now form the Blue Ridge anticlinorium, Smith River allochthon, and Sauratown Mountains anticlinorium and carved present-day topography. Following erosion, the area remained stable, apparently for a long period of time, as a thick saprolite has developed over almost all rocks of the area. This was followed by rejuvenation and a second cycle of erosion. Alluvial terraces along streams, deposited during this second cycle, and remnants of colluvial deposits are preserved along hill slopes. Valley fill presently being eroded in the heads of some streams indicates that the second erosional cycle might have been interrupted for a time by a depositional cycle.

ECONOMIC GEOLOGY

STONE

Gneissic parts of the Fork Mountain formation and gneiss in the Bassett formation, Leatherwood Granite and some lithologic units in the Rich Acres formation are potential sources of crushed and dimension stone. The major source of crushed stone in the Martinsville area has been the garnetiferous biotite gneiss in the Fork Mountain formation, which has been quarried at several localities in the Martinsville West quadrangle (Conley and Toewe, 1968, p. 31). A quarry prospect in this rock is located in the Price quadrangle approximately 0.5 mile downstream from the intersection of State Road 692 and Jennings Creek (Plate 3).

As the garnetiferous biotite gneiss of the Fork Mountain formation was produced by intense contact metamorphism and partial fusion of the originally heterogeneous mica schist by the Leatherwood Granite and Rich Acres formation its distribution within the area is controlled by the presence of the Leatherwood and Rich Acres. It generally occurs around margins of the broad valleys which are underlain by the intrusive rocks. The gneiss is variable in lithology, ranging from the massive granitic gneiss that is favored by the local stone producers, which occurs generally near the contact with the Rich Acres, to a micaceous hornfels high in aluminosilicate minerals at higher elevations above the contact zone.

The mica schist of the Fork Mountain formation has been quarried for road metal at the Franklin-Henry county boundary on Turkeycock Mountain in the Snow Creek quadrangle (Plate 1). The biotite gneiss in the Bassett formation is widespread, but has been quarried at only one location in the Bassett quadrangle (Henika, 1971, p. 37). This is probably due to both the poor exposure of the fresh rock in the mica content of the gneiss, which might cause bonding problems in a paving aggregate.

The Leatherwood Granite has been quarried at two localities near Horse Pasture. One abandoned quarry is in the Martinsville West quadrangle north of U. S. Highway 58 (Conley and Toewe, 1968, p. 32) and the other is adjacent to the highway 0.9 mile east of Horse Pasture Creek in the Price quadrangle. The Leatherwood has also been quarried for crushed stone in the Martinsville East quadrangle, east of U. S. Highway 58. Because it occurs principally as sheet-like bodies near the top of the igneous body and in dikes and sills cutting other rocks, the granite commonly contains large xenoliths of country rock that might cause problems in quality control. Many of the bodies shown on the maps are probably so shallow that they would not be economic for quarrying.

TALC AND SOAPSTONE

Altered ultramafic bodies are present in the rocks of the Smith River allochthon and the Sauratown Mountains anticlinorium. They generally contain impure concentrations of talc as granular bodies and schistose bands. Some are large enough to be of potential economic interest for quarrying as soapstone.

An ultramafic body approximately 2000 feet wide is exposed in the Snow Creek quadrangle along State Road 618 (Plate 1). It has been traced from the Bassett quadrangle to the southeastern fork of Fork Mountain. It contains olivine-chlorite-tremolite rock, talc-tremolite schist, and uralitic gabbro. The overall talc content is low and talc is localized within the mass. Small bodies occur elsewhere in the quadrangle in amphibolite on the southern fork of Fork Mountain and on Blue Mountain.

A sill-like body is present in gneiss of the Bassett formation along State Road 890, 1.7 miles northeast of Figsboro (Plate 1). It is poorly exposed at its southern end near Camp Branch Church on State Road 657 and along State Road 922 south of the Franklin-Henry county boundary. A pod-shaped ultramafic body occurs at the contact between the Bassett and Fork Mountain formations along the gas pipeline about 1.2 miles southeast of Figsboro (Plate 1). It contains talc-chlorite-cummingtonite schist and pyroxene-amphibole schist. A thin section from this locality (R-4659) contains about 10 percent talc. Another smaller body occurs along State Road 654 just south of Dyers Store.

Altered ultramafic rocks, talcose schists, and soapstone are exposed as tabular zones generally associated with leucrocratic granite dikes and sills that cut the Rich Acres formation (Plate 2). Some are distinct plutons with fairly sharp contacts, whereas others could be zones of alteration of the gabbroic rocks. The widest is in the Rich Acres formation about 0.5 mile east of Martinsville Reservoir. It is discontinuously exposed for approximately 2000 feet along a northwestward-trending ridge and mantled by deep residual soil that contains concentrations of magnetite. A soapstone deposit, possibly of economic value, crops out in the middle of the meander of the Smith River about 1.5 miles east of the Martinsville Speedway. Several thin elongate bodies are present to the northeast along strike in the area around the Patrick Henry Monument.

Large bodies of ultramafic rocks occur in the Ridgeway area (Plate 3). They are concordant stringers and pod-shaped masses in the Rich Acres formation along the Ridgeway fault. Large green boulders of massive, talc-chlorite-amphibole rock are present in the hillside east of U. S. Highway 220 at the northern town line. A similar rock is exposed along Surry Martin Branch south of the Ridgeway town line. A large body occurs east of, and is generally parallel to, the Norfolk and Western Railway. It has a trend to the northeast and is interlayered with schists of the Fork Mountain formation on Sheffield Hill. Relatively unweathered, altered ultramafic rocks crop out in a stream valley 0.4 mile southwest of the intersection of U. S. Highways 220 and 220 Bypass at the northern town limits. In the Ridgeway area, they generally contain more than 15 percent talc (R-4660) and may contain localized schistose zones that have much higher concentrations.

Thin, continuous layers of altered ultramafic rocks also occur in the gneiss and mica schist of the Sauratown Mountains anticlinorium in the Spray, Martinsville East, and Price quadrangles (Plates 2, 3). They are generally less than 20 feet wide and may contain greater concentrations of talc than some of the larger bodies in the Ridgeway area. A talc schist layer in the mica schist was traced more than a mile along State Road 646 in the Martinsville East quadrangle; a thin section from this layer (R-3795, Plate 2) contains approximately 80 percent talc.

MICA

Mica was mined continuously from before World War I to the end of World War II in the Chestnut Mountain area; mining in the Ridgeway area also occurred discontinuously during the same period (these mines are discussed in detail by Brown, 1962, p. 118-139, p. 151-163 and by Jahns and Griffitts, 1953, p. 170-191). The abandoned mines and prospect pits (Plates 1-3) are now generally filled with debris and overgrown by vegetation; some in the Ridgeway area have been completely covered by recent construction. In the Chestnut Mountain area, scrap and electrical-grade sheet mica were produced. Scrap mica, sheet mica, and some feldspar were produced in the Ridgeway area. Griffitts, Jahns and Lemke (1953, p. 148), who visited the mines in the Ridgeway area while the workings were accessible, state that many of the deposits were not exhausted when the mines closed. Some of the larger dumps in the area are also a possible source of scrap mica. Several mica-bearing pegmatites, previously unreported, were noted during the present study and are shown by symbols on Plates 1-3.

As it is now feasible to make wet-ground mica from mica schist (Lewis, Bundy and Wiener, 1971), the almost pure mica schist that occurs interbedded in the muscovite and muscovite biotite gneiss unit in the Price, Spray, and Martinsville East quadrangles is a potential source of ground mica. A thin section (R-4654, Plate 3) from one of these interbeds contains over 99 percent muscovite that occurs as silver-gray porphyroblasts 3 to 10 millimeters in diameter which contain less than 1 percent minute opaque mineral inclusions.

MAGNETITE

Localized concentrations of magnetite occur in the Fork Mountain formation. A magnetite prospect described by Nitze (1892, p. 181) was found near Martinsville (Plate 2). The debris-filled pit is on a ridge east of State Road 663, approximately one mile northeast of the Martinsville city limits. It is sunk into saprolite of mica schist which is the wall rock of the ore vein.

Magnetite in a prospect trench southwest of State Road 641 about 0.3 mile northwest of Fishers Dam (Plate 3) consists of lenticular blebs in a sheared kyanite-quartz hornfels. Weathered garnet dodecahedra up to 8 cm diameter are found in the saprolite walls of the trench. A sawed slab of rock (R-4692, Figure 27) from this locality contains approximately 40 percent massive magnetite; a matrix thin section contains approximately 30 percent kyanite, 30 percent potassic feldspar, 20 percent quartz, 10 percent muscovite, 5 percent staurolite, and 5 percent disseminated magnetite.

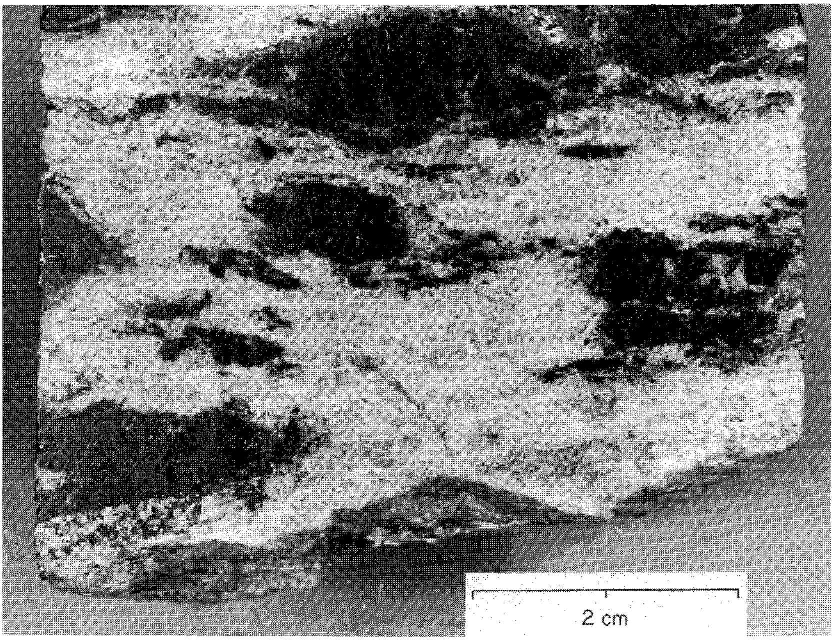


Figure 27. A sawed slab showing magnetite in sheared kyanite-quartz hornfels (R-4692), from a prospect north of Fishers Dam, Spray quadrangle.

Similar magnetite crops out on the eastern slopes of Chestnut Knob and also along State Road 687 about 0.1 mile northeast of Mount Zion Church (Plate 3). It is a stratiform body less than 2 feet thick that is interlayered with mica schist and quartzite. A prospect was found near Martinsville (Plate 2). The debris-filled pit is on a ridge east of State Road 663, approximately one mile northeast of the Martinsville city limits. It is sunk into saprolite of mica schist which is the wall rock of the ore vein.

Magnetite in a prospect trench southwest of State Road 641 about 0.3 mile northwest of Fishers Dam (Plate 3) consists of lenticular blebs in a sheared kyanite-quartz hornfels. Weathered garnet dodecahedra up to 8 cm diameter are found in the saprolite walls of the trench. A sawed slab of rock (R-4692, Figure 27) from this locality contains approximately 40 percent massive magnetite; a matrix thin section contains approximately 30 percent kyanite, 30 percent potassic feldspar, 20 percent quartz, 10 percent muscovite, 5 percent staurolite, and 5 percent disseminated magnetite.

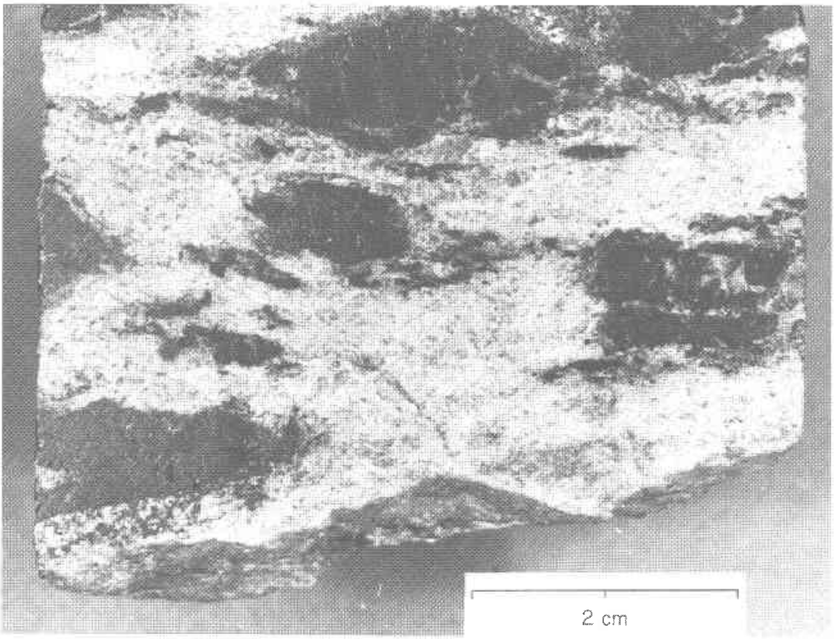


Figure 27. A sawed slab showing magnetite in sheared kyanite-quartz hornfels (R-4692), from a prospect north of Fishers Dam, Spray quadrangle.

Similar magnetite crops out on the eastern slopes of Chestnut Knob and also along State Road 687 about 0.1 mile northeast of Mount Zion Church (Plate 3). It is a stratiform body less than 2 feet thick that is interlayered with mica schist and quartzite. A prospect pit in the deposit occurs 1200 feet south of the outcrop on State Road 687. A thin section from the outcrop (R-4715) consists of approximately 60 percent magnetite (intergrown with other opaque minerals), 25 percent quartz, 10 percent kyanite, 2 percent monazite, and traces of corundum, sillimanite, zircon, and hematite. The rock has a granoblastic texture owing to coarse irregular magnetite grains that have crystallized around quartz, euhedral sillimanite, and monazite. The monazite is rounded and embayed by the magnetite. Mertie (1955) described this locality as a fossil monazite placer and considered the monazite to be of detrital origin. Kyanite and garnet form reaction rims that completely mantle quartz grains included in the magnetite. Corundum is concentrated in the magnetite as microscopic intergrowths similar to those associated with emery deposits in the area.

Local concentrations of magnetite occur in the Rich Acres formation. Several prospect pits are located along a farm road at a point one mile N.42°E. of the Chestnut Knob Lookout Tower (Plate 3) and pits are sunk into deep residual soil. Magnetite is found in the small dumps adjacent to the pits.

EMERY

Coarse, granular emery occurs as isolated boulders in the residual soil overlying the Rich Acres formation. Emery, composed of corundum and magnetite, is present west of Leatherwood Creek approximately 1.4 miles S.25°W. of Blue Knob (Plate 1). Corundum-magnetite-spinel emery was found (1) along State Road 641 south of Smith River, about 0.5 mile west of Fishers Dam (R-4691, Plate 3) and (2) on the northern end of Sheffield Hill along a private lane about 1.6 miles N.36°E. of the intersection of State Roads 782 and 992 (R-4690, Plate 3). The spinel-bearing emery is a dark greenish-gray rock composed primarily of interlocking grains of hercynite and magnetite that enclose skeletal crystals of corundum (Figure 28, R-4691). The dark-green hercynite is rimmed by brown hoegbomite, apparently formed by deuteuric alteration of the spinel (Watson, 1925).

The percentages of constituent minerals are variable from locality to locality. Hercynite ranges from 20 to 70 percent, corundum 10 to 40 percent, and magnetite 5 to 40 percent. Kyanite occurs from traces to 10 percent. Staurolite and garnet are present in minor amounts in the corundum-magnetite emery near Blue Knob (Plate 1). Pale-green chlorite is a common alteration in samples from all localities. The composition of emery from the area of this report as well as that reported from the Martinsville West quadrangle (Conley and Toewe, 1968, p. 33) is similar to that from Pittsylvania County, Virginia

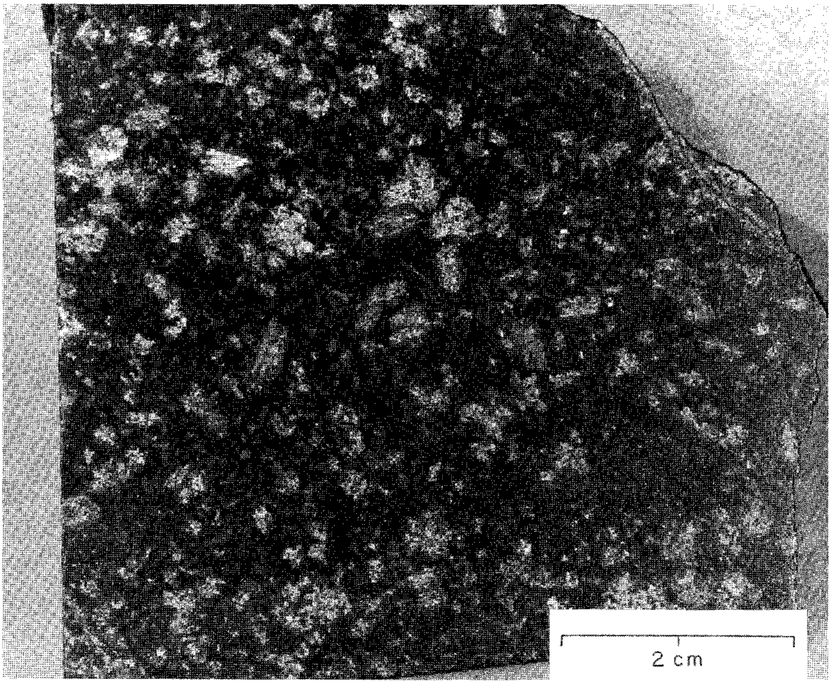


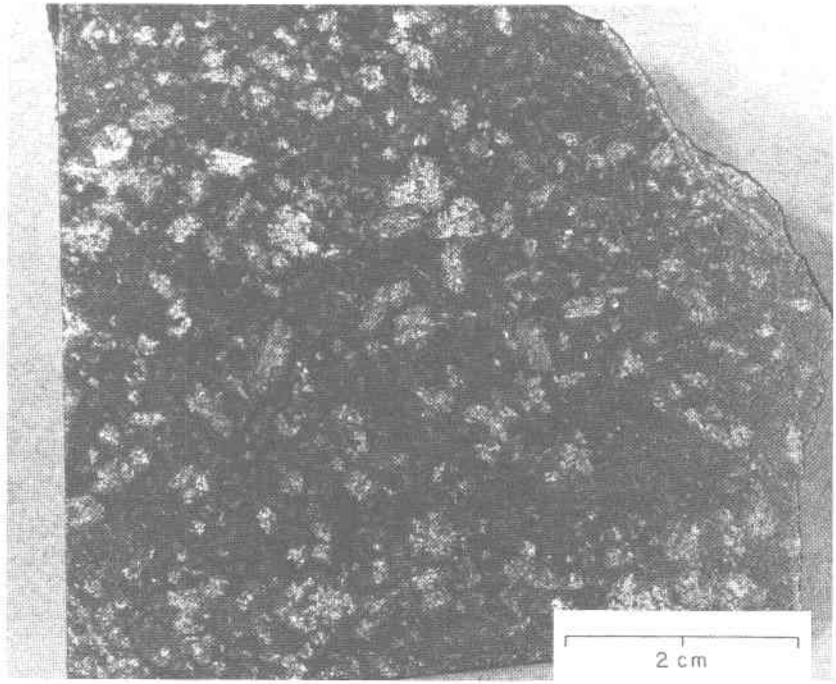
Figure 28. A sawed slab of spinel emery (R-4691), along State Road 641 northeast of Ridgeway, Spray quadrangle; dark minerals are intergrown magnetite, spinel (hercynite) and hoegbomite; light gray minerals are corundum and kyanite.

(Watson, 1925) and from the Cortlandt Complex, New York (Friedman, 1956).

SILLIMANITE AND KYANITE

Fibrolite is disseminated in schist of the Fork Mountain formation as part of an early regional metamorphic mineral assemblage. It is generally replaced by sericite except at the locality on the northeastern end of Turkeycock Mountain (shown on Plate 1 as R-4636) where the early regional metamorphic assemblage is preserved. A thin section of the rock (R-4635) contains approximately 20 percent sillimanite, principally fibrolite, that is intermingled with biotite folia along schistosity.

The major concentrations of aluminosilicate minerals occur in the contact aureole adjacent to the Leatherwood Granite and Rich Acres formation (Figure 29). As previously noted the aureole may be several hundred feet thick above the gently undulose contact with the igneous rocks. Because of its nearly horizontal attitude, the aureole covers a



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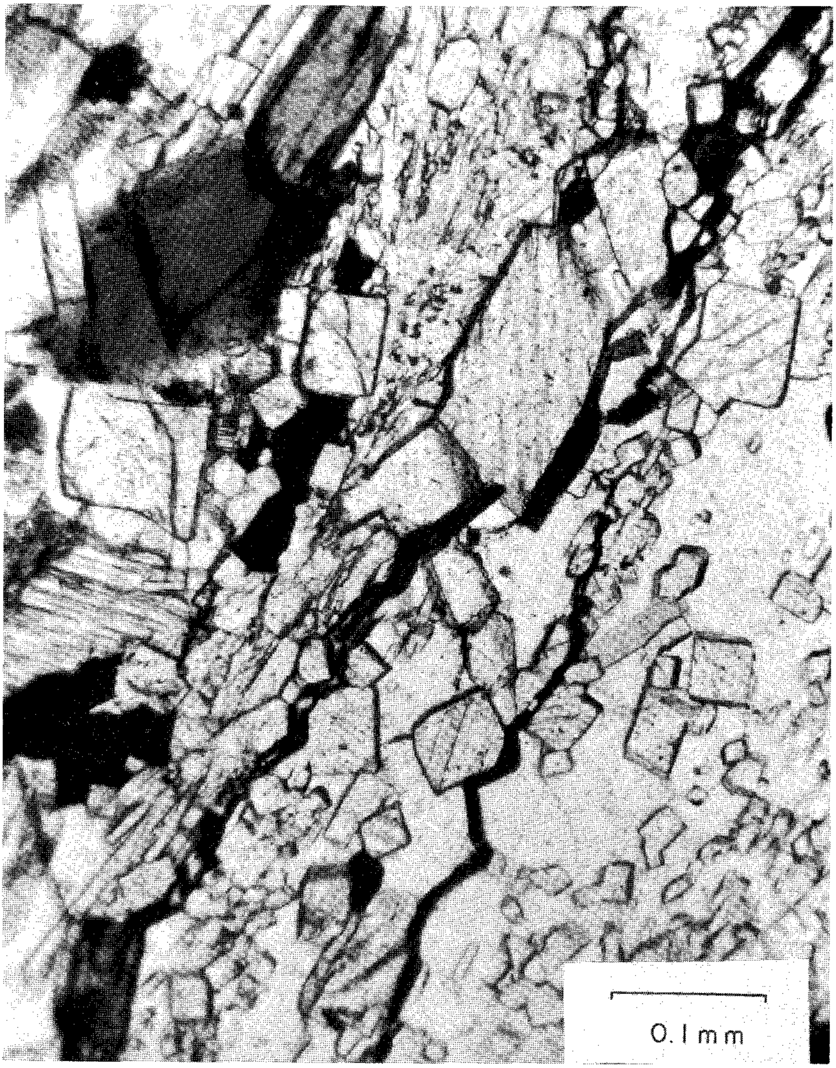
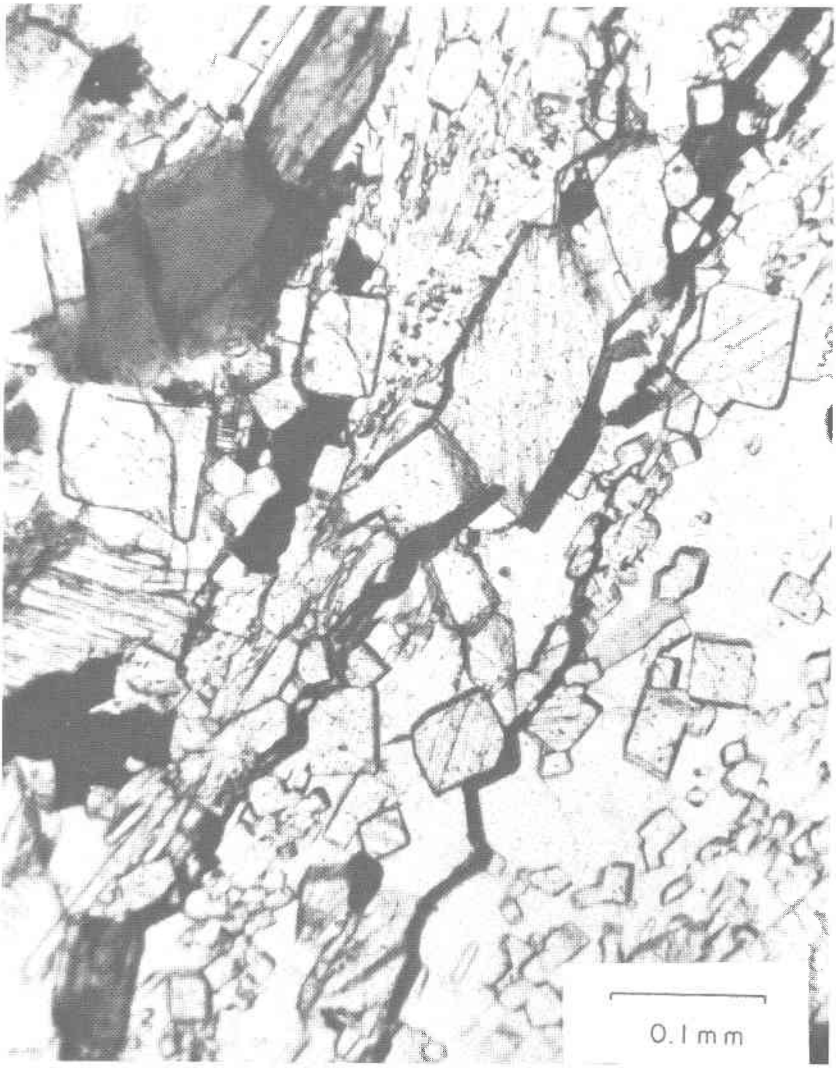


Figure 29. Photomicrograph of sillimanite in hornfels (R-4724), Chestnut Knob, Price quadrangle; dark minerals are magnetite and biotite; plane-polarized light.

large area, and the aluminosilicate-rich rocks are therefore also widespread. Kyanite is generally most abundant in the mica schist at higher levels in the zone, whereas sillimanite is more abundant in the hornfelsic gneiss close to the contact with the igneous mass.

A high concentration of kyanite and sillimanite occurs in an area east of Martinsville, centered around a small knob located approxi-



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A high concentration of kyanite and sillimanite occurs in an area east of Martinsville, centered around a small knob located approximately 0.2 mile south of Woodland Heights Church, 0.6 mile east of the city limits (Plate 2). A vertical section of approximately 300 feet of aluminosilicate-rich hornfelsic rocks is exposed from the top of the highest knob of schist in the area to the level of the intrusive rocks in the valleys surrounding it. Seven thin sections of rocks

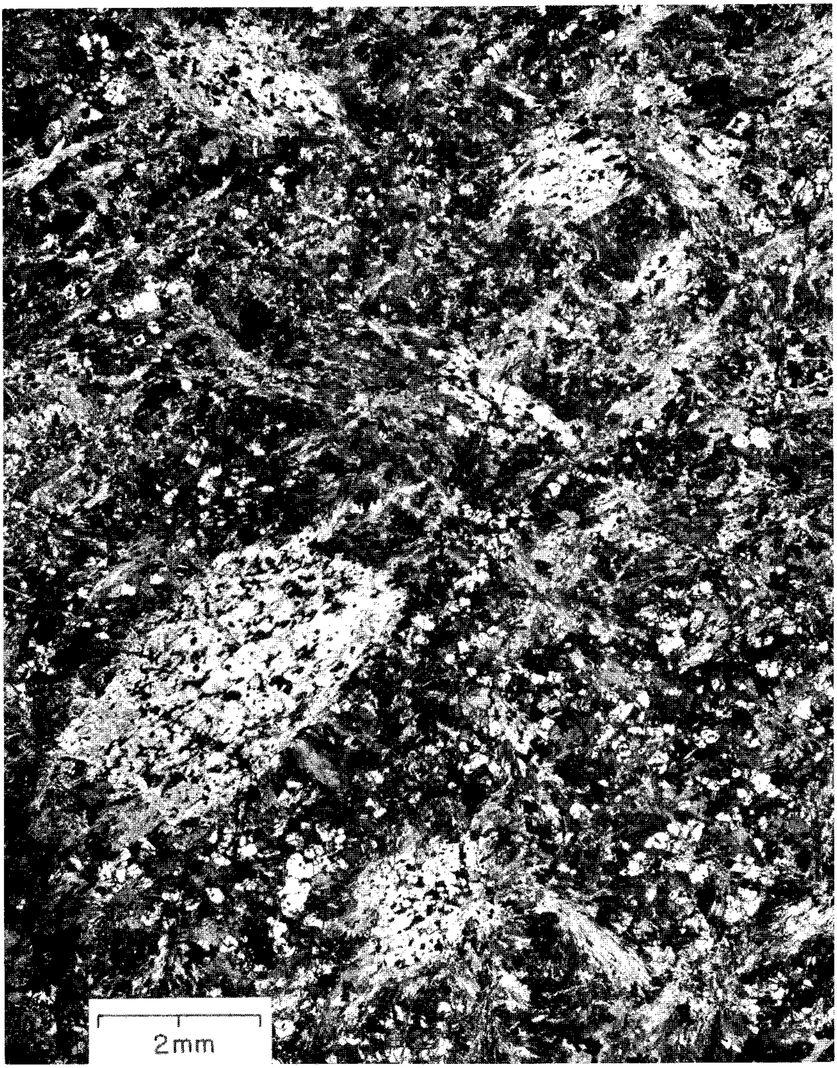

Figure 30. Photomicrograph of hornfels (R-4724), knob approximately 0.5 mile southeast of Woodland Heights Church, Martinsville East quadrangle; cross-polarized light.

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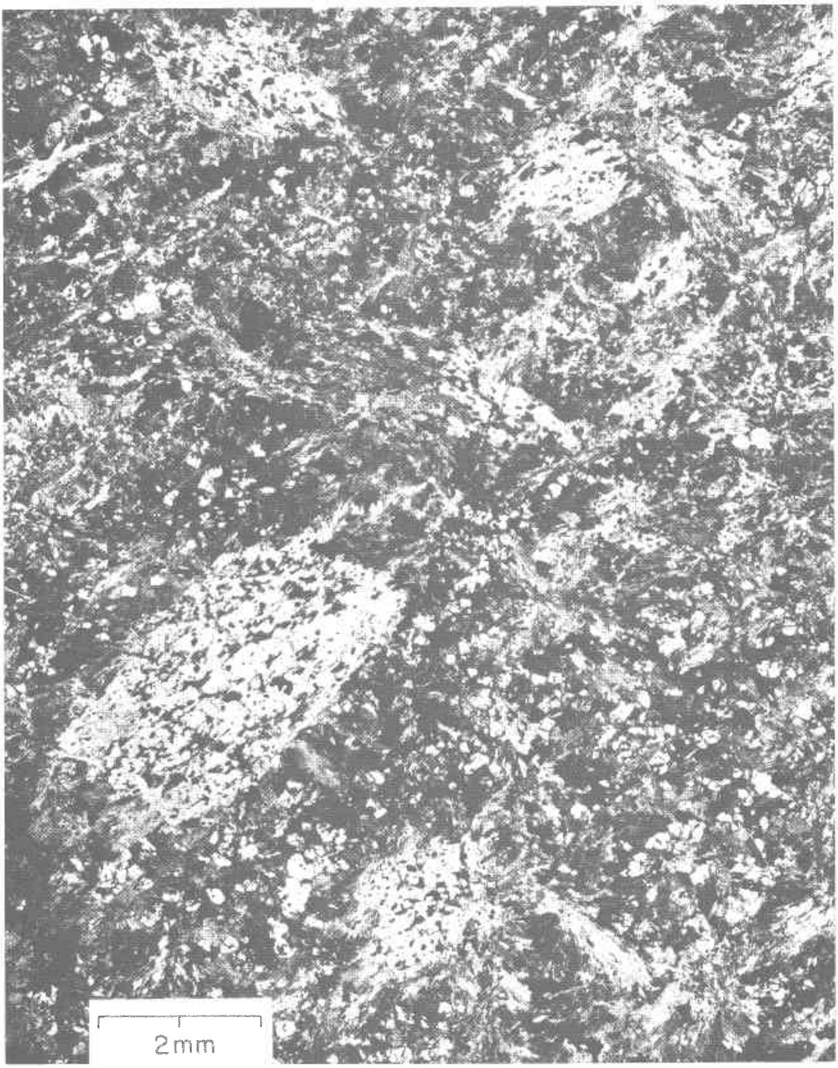

Figure 30. Photomicrograph of hornfels (R-4724), knob approximately 0.5 mile southeast of Woodland Heights Church, Martinsville East quadrangle; cross-polarized light.

collected within a 0.5 mile radius from the knob contain an average of 18 percent kyanite and 8 percent sillimanite.

Chestnut Knob (Plate 3) is a central ridge that is underlain by the Fork Mountain formation and is flanked on both the east and the west by broad valleys underlain by the Leatherwood Granite and Rich Acres formation. At this locality, over 500 feet of vertical section is exposed containing hornfelsic rocks. Thirteen thin sections collected within a one-mile radius of Chestnut Knob contain an average of 17 percent kyanite and 5 percent sillimanite. Local concentrations of magnetite (up to 20 percent) are generally associated with the contact assemblages throughout the area (Figures 8, 9, 10, 11, 12, 29, 30); therefore, the rocks with anomalous concentrations of aluminosilicate minerals have a higher magnetic susceptibility. This relationship may prove valuable as an aid to prospecting for sillimanite and kyanite.

Kyanite occurs in the garnet-mica schist of the Sauratown Mountains anticlinorium. It has a spotty distribution within the unit and no major concentrations were found in the formation. Kyanite is reported as part of the regional metamorphic assemblage of the schist in Stokes and Surry counties, North Carolina (Butler and Dunn, 1968, p. 43-44, and Espenshade and Potter, 1960, p. 64). A concordant kyanite-rich zone occurs in the schist at the Virginia-North Carolina boundary in the central part of the Price quadrangle and is traceable for a few hundred yards northward.

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GLOSSARY[1]

allochthon—A mass of rocks which has been moved from its site of origin by tectonic forces, as in a thrust sheet or nappe.

anticlinorium—An anticlinal structure of regional extent composed of lesser folds.

antiform—An anticline-like structure in which the stratigraphic sequence is not known.

augen—In foliate metamorphic rocks such as schists and gneisses, large, lenticular mineral grains or aggregates which have the shape of an eye in cross section, in contrast to the shapes of other minerals in the rock.

cataclasis—Rock deformation effected by fracture and rotation of mineral grains or aggregates without chemical reconstitution.

dêcollement—Detachment structure of strata due to deformation, which results in independent styles of deformation in the rocks above and below.

decussate structure—A microstructure in thermally metamorphosed rocks with the axes of contiguous crystals lying in diverse, criss-cross directions which are not random but rather are part of a definite mechanical expedient for minimizing internal stress.

flaser gneiss—A structure in dynamically metamorphosed rock in which lenses and layers (*flaser*) of original or relatively unaltered granular minerals are enclosed by a matrix of highly sheared and crushed material giving the appearance of a crude flow structure.

granoblastic—The texture of metamorphic rocks composed of equidimensional elements with normally well-sutured boundaries.

granofels—A field name for a medium- to coarse-grained granoblastic metamorphic rock, having little or no foliation or lineation.

hornfels—A fine-grained rock composed of a mosaic of equidimensional grains without preferred orientation and typically formed by contact metamorphism. "The term hornfels was originally applied only to fine-grained and dark-colored thermal metamorphic rocks, but is now used as a general class name for all thermal metamorphic rocks" (Spry, 1969, p. 186).

kelyphitic rims—Reaction rim, secondary rims in metamorphic rocks (Spry, 1969, p. 105).

ophitic texture—Term for holocrystalline, hypidiomorphic-granular texture of an igneous rock (especially diabase) in which lath-shaped crystals of plagioclase are partially to completely included in pyroxene crystals (typically augite).

photomicrograph—A photographic enlargement of a microscopic object such as a petrologic thin section.

phyllite—An argillaceous rock commonly formed by regional metamorphism and intermediate in metamorphic grade between slate and schist. Minute sericite and chlorite crystals impart a silky sheen to the cleavage surface.

phyllonite—Phyllite-mylonite; a rock of phyllitic appearence formed by mylonization of an originally coarser grained rock (Higgins, 1971, p. 75).

pluton—An igneous intrusion; a term which embraces all intrusive bodies of igneous rock (Turner and Verhoogen, 1951, p. 66).

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[1] Definitions predominantly adapted from American Geological Institute (1972).

poikilitic—Said of the texture of an igneous rock, having small crystals of one mineral (e.g. plagioclase) which are irregularly scattered without common orientation in a larger crystal of another mineral (e.g. pyroxene).

poikiloblastic—Said of a metamorphic texture which resulted from the development, during recrystallization, of a new mineral around numerous relicts of the original minerals, thus simulating poikilitic texture of igneous rocks.

porphyroblast—A pesudoporphyritic crystal in a rock, resulting from thermodynamic metamorphism.

postkinematic—Posttectonic = postorogenic; said of a geologic process or event which occurred after any kind of tectonic activity; or said of a rock or feature so formed.

pesudomorph—A mineral whose outward crystal form is that of another mineral species; it has been formed by alteration, substitution, incrustation, or paramorphism.

ptygmatic fold—Ptygma; pegmatite material within migmatite or gneiss, having the appearance of disharmonic folds (Dietrich, 1959, p. 358).

rapakivi—An igneous texture found in granites in which a single large rounded crystal of potash feldspar is enclosed in a polycrystalline rim of small oligoclase grains (Turner and Verhoogen, 1951, p. 363).

relict—Pertaining to a mineral, structure, or feature of a rock that represents those of an earlier rock and which persist in spite of processes tending to destroy it, e.g. metamorphism.

saprolite—Soft, clay-rich, thoroughly decomposed, but untransported, rock formed in place by chemical weathering of igneous and metamorphic rocks.

sieve texture—A texture in metamorphic and some igneous rocks produced by inclusions of a mineral or glass in larger spongy crystals of another species.

skialith—A vague remnant of country rock in bodies of igneous or metamorphic rocks.

subhedral—Said of an individual mineral crystal, in an igneous rock, that is partly faced or incompletely bounded by its own crystal faces and partly bounded by surfaces formed against preexisting minerals.

subophitic—Said of the ophitic texture of an igneous rock, having the feldspar crystals approximately the same size as the pyroxene and only partly included by them.

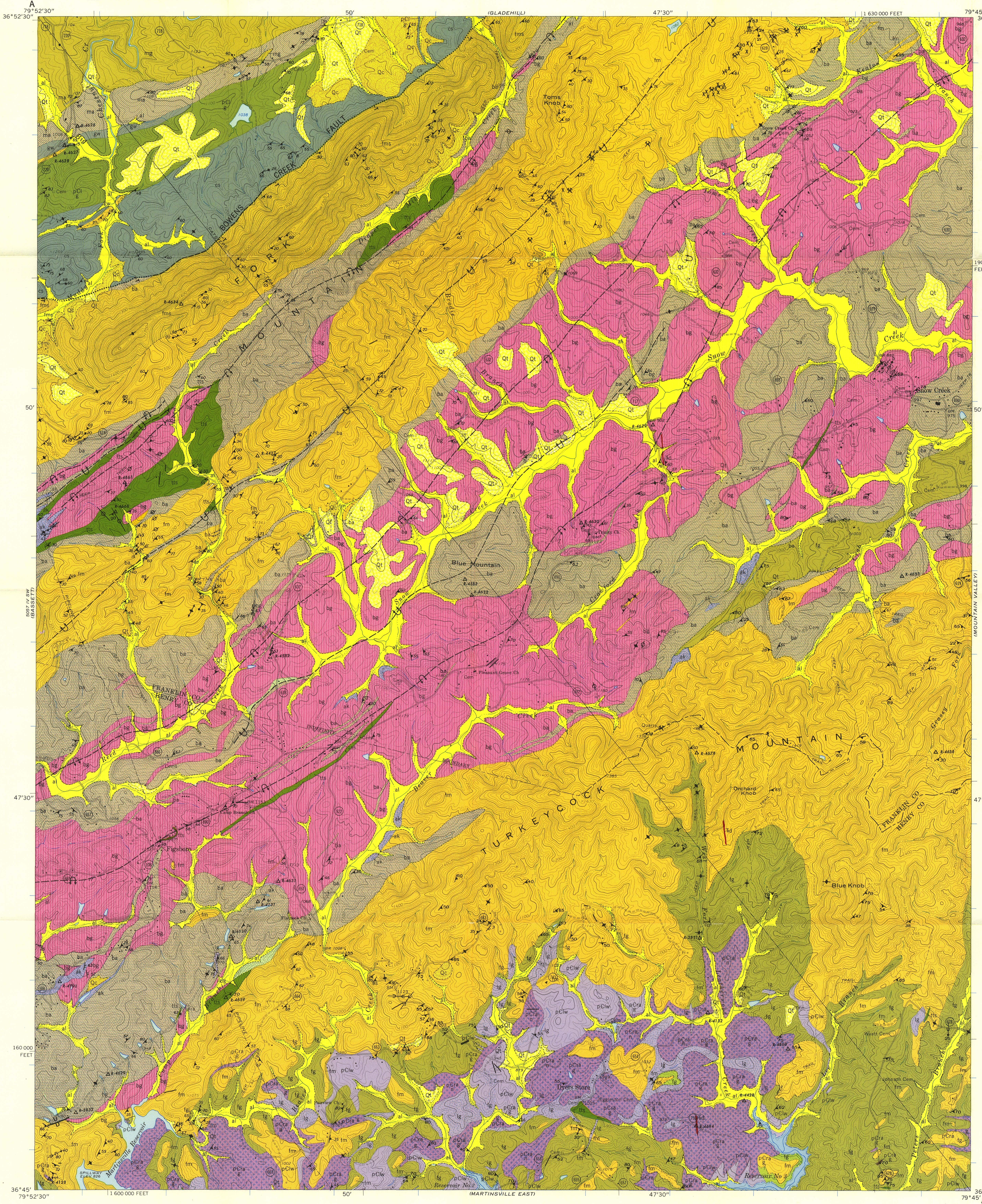
synform—A synclinal-like structure, the stratigraphic sequence of which is unknown.

INDEX

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

9 Aug 72

REPORT OF INVESTIGATIONS 33
PLATE 1



EXPLANATION

QUATERNARY

HOLOCENE

al

Alluvium
Gray and brown silts and sands containing cobbles at the base.

Qt

Alluvial terrace deposits
Rounded cobbles and boulders in red silt and sand matrix, some contain white clay layers.

Qc

Colluvium
Angular quartz and lithic cobbles and boulders in red silt and clay matrix.

TRIASSIC

Ꞧd

Diabase dikes
Melanocratic, generally fine-grained, olivine-pyroxene diabase.

PRECAMBRIAN

ak

Alaskite
Sheared and foliated, generally conformable, leucocratic granite and pegmatite.

tts

Altered metapyroxenite and talc schist
Small mafic plutons, some of which are discordant, generally altered to talc but contains some relic pyroxene, chlorite, cummingtonite, and tremolite-actinolite.

cs

Schist
Muscovite-chlorite schist and phyllite derived predominantly from deformation of the Lynchburg Formation; shear zones are adjacent to the schist on the southeast and northwest.

g | p€l gw | m

Lynchburg Formation
g: *silvery gray muscovite-sericite gneiss, contains some graphite;* gw: *metagraywacke, metagraywacke conglomerate, and quartzite;* m: *metagabbro.*

n | p€ra d | g

Rich Acres formation
n: *dark-gray, coarse-grained to porphyritic norite, has some ophitic texture;* d: *medium- to dark-gray, medium- to coarse-grained quartz diorite and diorite;* g: *predominantly fine- to medium-grained gabbro and hornblende metagabbro; and contains some quartz diorite, diorite, and norite.*

lg
p€lw

Leatherwood Granite
lg: *coarse-grained to porphyritic, pegmatitic leucocratic granite, microcline phenocrysts have some rapakivi texture;* p€lw: *rapakivi granite.*

fms | fm | fg

Fork Mountain formation
fms: *gray, garnetiferous chloritoid-mica schist containing sericite pseudomorphs after staurolite and relic partially altered staurolite grains;* fm: *silvery-gray, medium-grained, garnetiferous chloritoid-mica-sillimanite,schist contains some quartzite interlayers;* fg: *coarse- to medium grained, light-gray, garnetiferous biotite gneiss; contains some quartzite layers and alumino-silicate rich zones.*

ba
bg

Bassett formation
ba: *gneissic to schistose, dark-green to black amphibolite, contains epidote rich layers and pyroxene granofels bodies;* bg: *medium- to fine-grained, leucocratic segregation, banded biotite gneiss, contains some minor amphibolite layers.*

ma
mg

Moneta gneiss
ma: *greenish-black, fissile amphibolites ranging to amphibole schist and gneiss;* mg: *coarse-grained mica gneiss showing well developed planar foliation and poorly developed compositional banding.*

CONTACTS

———	exposed
- - - - -	approximate
....	covered or inferred

FOLDS

←⋂– – –	Overturned anticline—trace of axial plane and direction of plunge of axis
←⋃– – –	Overturned syncline—trace of axial plane and direction of plunge of axis
	Direction of minor anticline
	Direction of minor syncline
	Direction and angle of dip of axial plane of minor overturned anticline
5	Direction and angle of plunge of minor plunging anticline
57	Direction and angle of plunge of minor plunging syncline
40 80	Direction, angle of plunge, and angle of dip of axial plane of minor overturned plunging anticline

FOLIATION AND CLEAVAGE

40	Strike and dip of inclined foliation
	Strike of vertical foliation
8	Strike and dip of inclined fracture cleavage
25	Strike and dip of inclined compositional banding
57	Strike and dip of overturned bedding

LINEATIONS

20 ↙	Bearing and plunge of mineral lineation
↙↗	Bearing of horizontal mineral lineation
25	Bearing and plunge of rodding, boudinage and crinkle folds

FAULTS

THRUST

——T——....	T — overthrust side

NORMAL OR REVERSE

——U/D——....	U — upthrown side D — downthrown side

SAMPLE LOCATIONS

△ R-4130	Location and repository number of sampled lithology

QUARRY, MINES AND PROSPECTS

Abandoned Quarry and Mines

⚒	mica
⚒ms	mica schist (quarry)

Prospects

x	mica

PEGMATITE DIKE OR SILL

—	Strike of pegmatite dike or sill

QUARTZ VEIN

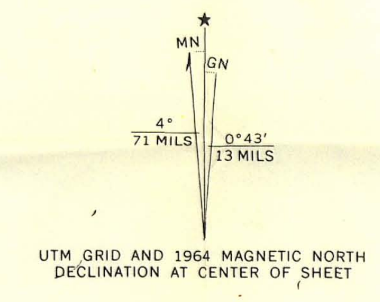
⊖	Strike of quartz vein

Base map from U. S. Geological Survey, 1966
Snow Creek Quadrangle, 7½ Minute Series

Williams & Heintz Map Corporation

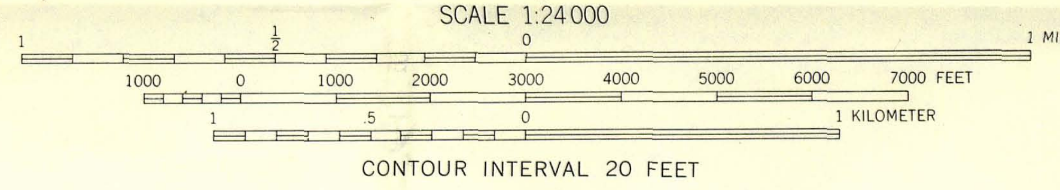
GEOLOGIC MAP OF THE SNOW CREEK QUADRANGLE, VIRGINIA

Geology by James F. Conley, and Paul C. Ragland



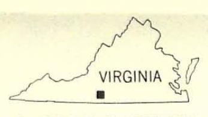
UTM GRID AND 1964 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SCALE 1:24000

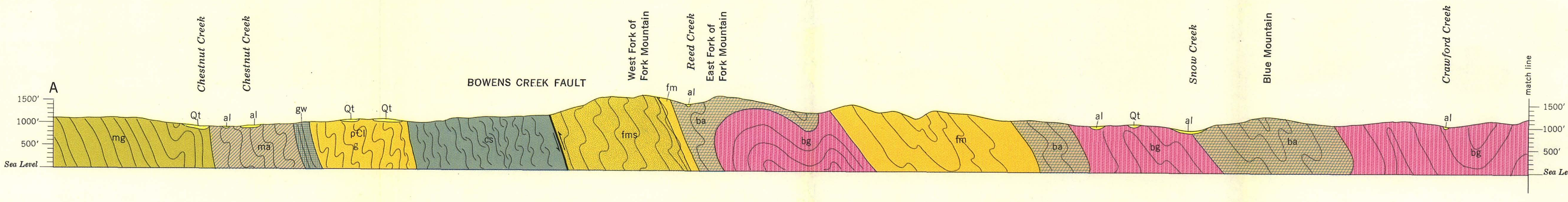


CONTOUR INTERVAL 20 FEET

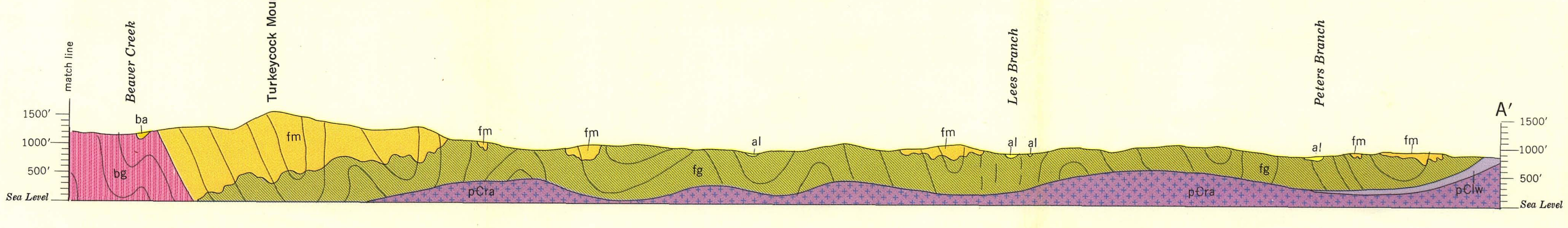
1972



QUADRANGLE LOCATION



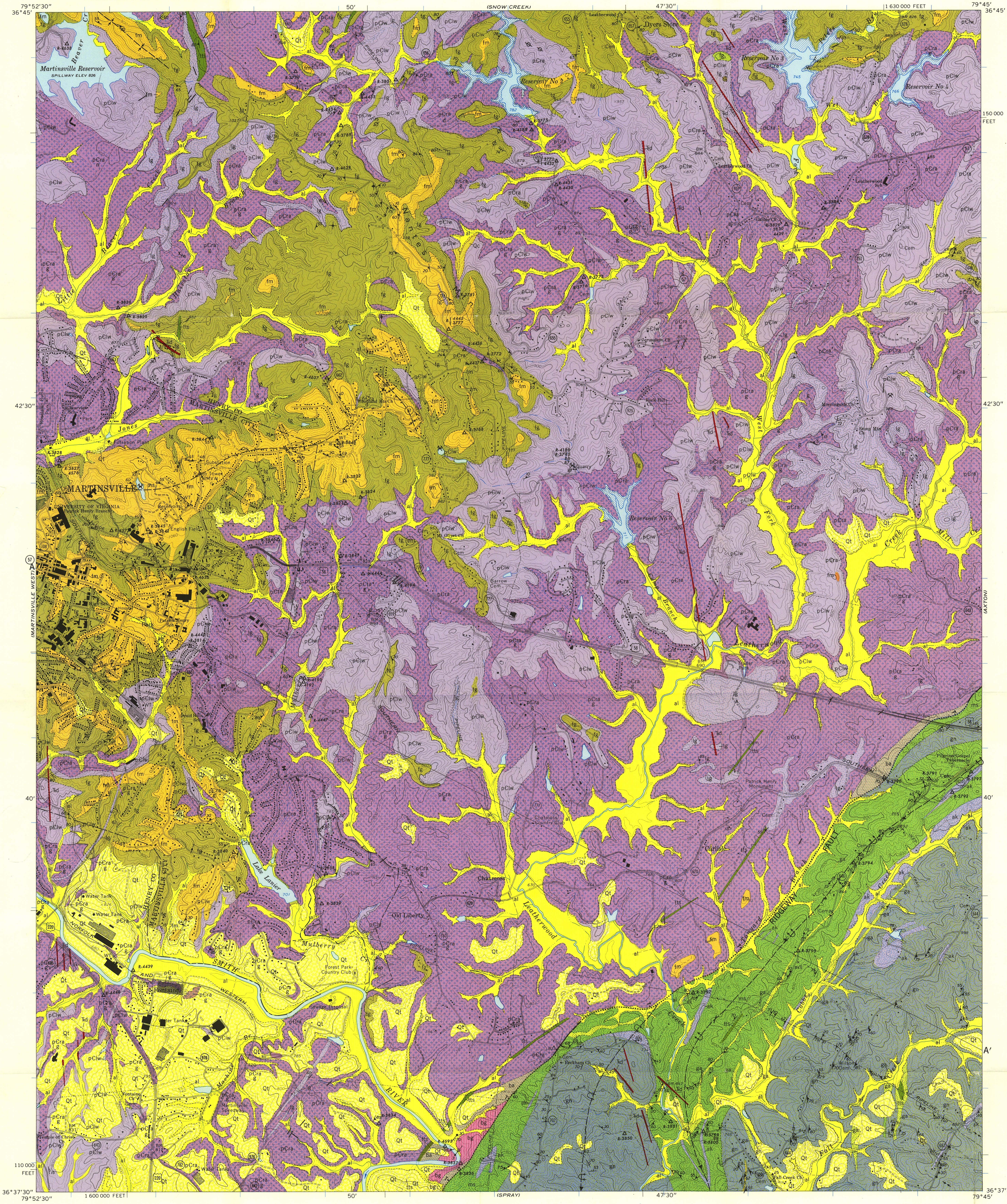
Interpretive cross section with no vertical exaggeration



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 33
PLATE 2

9Aug82
KH



EXPLANATION

QUATERNARY

HOLOCENE

al

Alluvium

Gray and brown silts and sands containing cobbles at the base.

Qt

Alluvial terrace deposits

Rounded cobbles and boulders in red silt and sand matrix, some contain white clay layers.

Qc

Colluvium

Angular quartz and lithic cobbles and boulders in red silt and sand matrix.

TRIASSIC

Ћd

Diabase dikes

Melanocratic, generally fine-grained, olivine-pyroxene diabase.

PRECAMBRIAN

ak

Alaskite

Sheared and foliated, generally conformable, leucocratic granite and pegmatite.

tts

Altered metapyroxenite and talc schist

Small mafic plutons, some of which are discordant, generally altered to talc but contains some relic pyroxene, chlorite, cummingtonite, and tremolite-actinolite.

ga | gn | ms

Gneiss and mica schist

ga: *dark-green to black garnet-hornblende schist and garnetiferous amphibolite.* gn: *muscovite and muscovite-biotite gneiss with interlayered mica schist, graphite-mica schist, and feldspathic quartzite; contains some garnet-hornblende schist.* ms: *garnet-mica schist, contains some kyanite and staurolite; has interlayered micaceous quartzite, garnet-mica gneiss, calc-gneiss, and graphitic schist layers.*

n | p€ra d | g

Rich Acres formation

n: *dark-gray, coarse-grained to porphyritic norite, some has ophitic texture;* d: *medium- to dark-gray, medium- to coarse-grained quartz diorite and diorite;* g: *predominantly fine- to medium-grained gabbro and hornblende metagabbro and contains some quartz diorite, diorite, and norite.*

lg | p€lw

Leatherwood Granite

lg: *coarse-grained to porhpyritic, pegmatitic leucocratic granite, microcline phenocrysts have some rapakivi texture;* p€lw: *rapakivi granite.*

fm | fg

Fork Mountain formation

fm: *silvery-gray, medium-grained, garnetiferous chloritoid-mica schist containing relic sillimanite and sericite pseudomorphs after sillimanite, may contain quartzite interlayers;* fg: *coarse- to medium-grained, light-gray, garnetiferous biotite gneiss, contains some quartzite layers and alumino-silicate rich zones.*

ba | bg

Bassett formation

ba: *gneissic to schistose dark-green to black amphibolite, contains some epidote rich layers and pyroxene granofels bodies;* bg: *medium- to fine-grained, segregation banded, leucocratic biotite gneiss, contains some minor amphibolite layers, epidote-rich zones and augen-gneiss facies adjacent to mafic intrusions.*

CONTACTS

———	exposed
- - - - -	approximate
·········	covered or inferred

FOLDS

←┼--	Syncline—trace of axial plane and direction of plunge of axis
←∩--	Overturned anticline—trace of axial plane and direction of plunge of axis
←∪--	Overturned syncline—trace of axial plane and direction of plunge of axis
	Direction of minor anticline
	Direction of minor syncline
30	Direction and angle of dip of axial plane of minor overturned anticline
15	Direction and angle of plunge of minor plunging anticline
20	Direction and angle of plunge of minor plunging syncline
20 30	Direction, angle of plunge, and angle of dip of axial plane of minor overturned plunging anticline

FOLIATION AND CLEAVAGE

80	Strike and dip of inclined foliation
	Strike of vertical foliation
+	Horizontal foliation
55	Strike and dip of inclined compositional banding
	Strike of vertical compositional banding

LINEATIONS

7	Bearing and plunge of mineral lineation
↗	Bearing ot horizontal mineral lineation
70	Bearing and plunge of rodding, boudinage and crinkle folds
	Bearing of horizontal rodding, boudinage and crinkle folds

FAULTS

THRUST

——┬——···	T — overthrust side

SAMPLE LOCATIONS

△ . R-3800	Location and repository number of sampled lithology

QUARRIES, MINE AND PROSPECTS

Abandoned Quarries and Mine

⚒	mica (mine)
⚒gr	granite
⚒gn	gneiss
⚒ms	mica schist

Prospects

x	mica
x fe	magnetite

PEGMATITE DIKE OR SILL

—	Strike of pegmatite dike or sill

QUARTZ VEIN

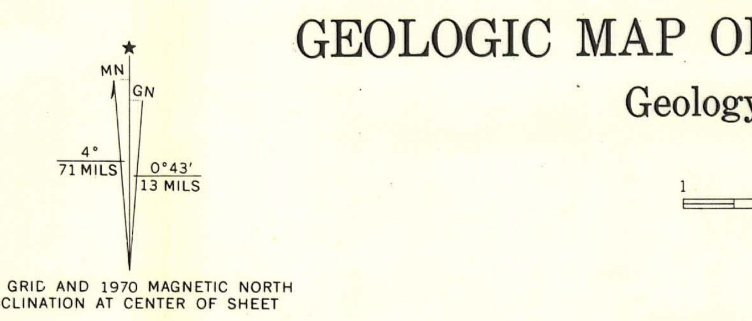
⊖	Strike of quartz vein

Base map from U. S. Geological Survey, 1966
Martinsville East Quadrangle, 7½ Minute Series

Williams & Heintz Map Corporation

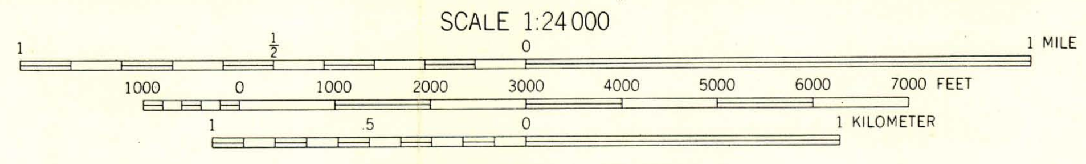
GEOLOGIC MAP OF THE MARTINSVILLE EAST QUADRANGLE, VIRGINIA

Geology by James F. Conley, William S. Henika, and John R. Algor



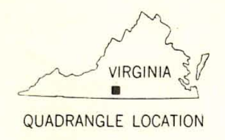
UTM GRID AND 1970 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SCALE 1:24 000



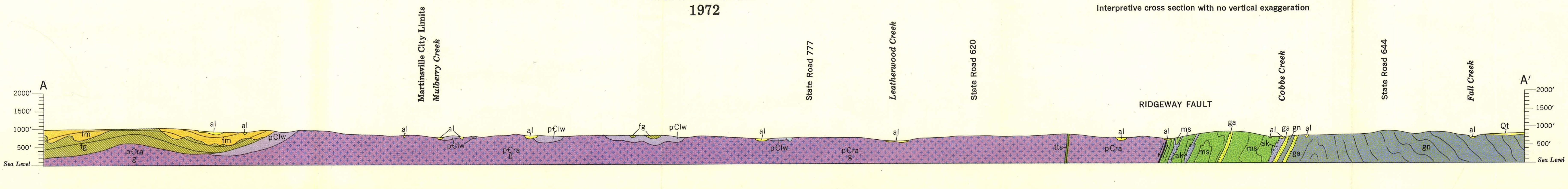
CONTOUR INTERVAL 20 FEET
DATUM IS MEAN SEA LEVEL

1972



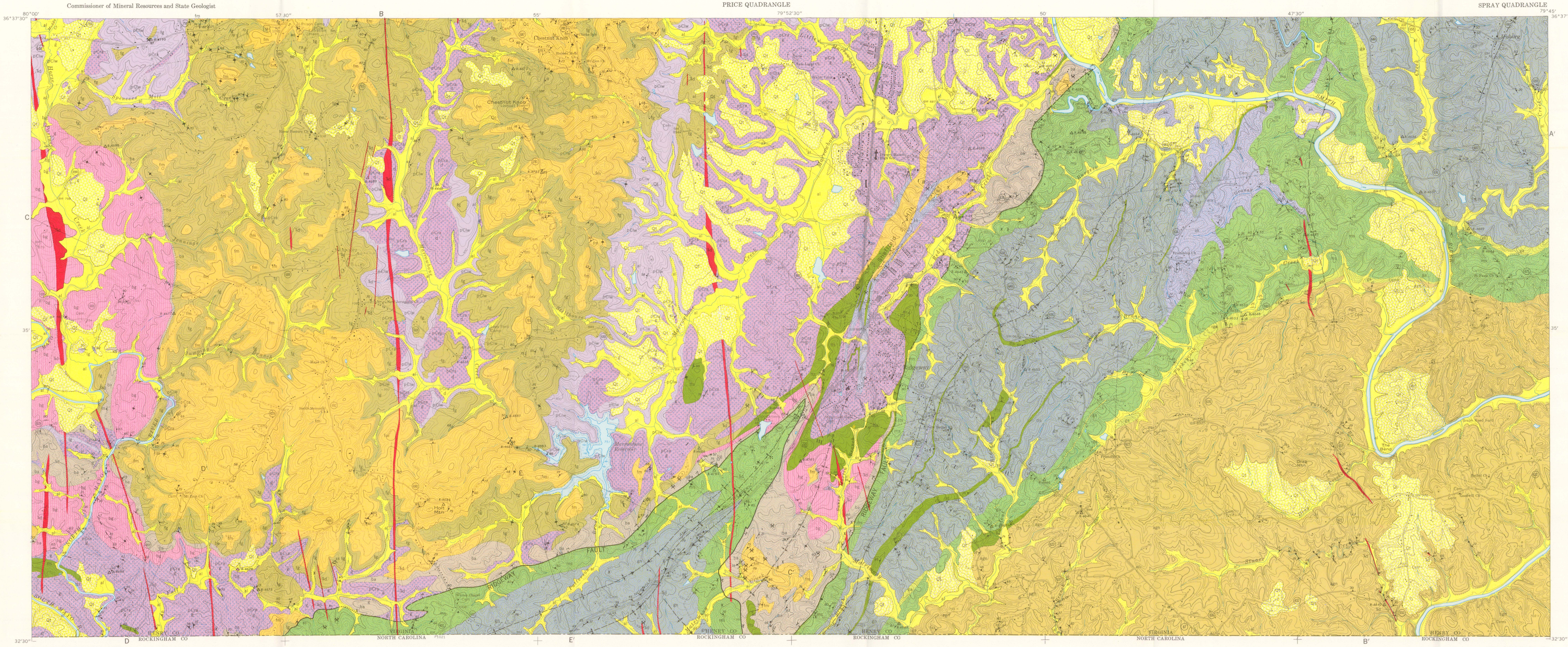
QUADRANGLE LOCATION

Interpretive cross section with no vertical exaggeration



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 (33)
PLATE 3

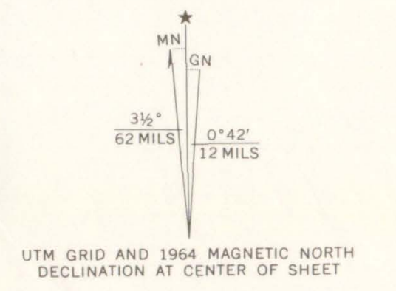


Base map from U. S. Geological Survey, 1964
Price-Spray Quadrangles, 7½ Minute Series

Williams & Heintz Map Corporation

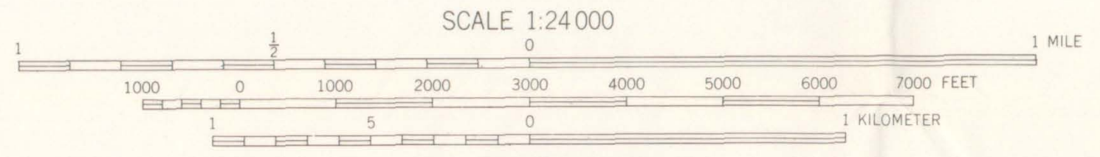
GEOLOGIC MAP OF THE PRICE AND SPRAY QUADRANGLES, VIRGINIA

Geology by William S. Henika and John R. Algor



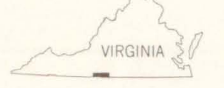
UTM GRID AND 1964 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SCALE 1:24 000



CONTOUR INTERVAL 20 FEET
DATUM IS MEAN SEA LEVEL

1972



QUADRANGLE LOCATION

Interpretive cross section with no vertical exaggeration

EXPLANATION

QUATERNARY

HOLOCENE

al — Alluvium
Gray and brown silts and sands containing cobbles at the base at some localities and gray clays at the base at other places.

Qt — Alluvial terrace deposits
Rounded cobbles and boulders in a red silt and clay matrix; some white sand layers along Smith River.

Qc — Colluvium
Angular quartz and lithic cobbles and boulders in red silt and clay matrix.

TRIASSIC

₸d — Diabase dikes
Melanocratic, generally fine-grained, olivine-pyroxene diabase.

PRECAMBRIAN

ak — Alaskite
Foliated, leucocratic granite sills and dikes.

tts — Talc schist
Altered ultramafic rocks, generally schistose in character, containing variable amounts of serpentine, talc, chlorite, tremolite, cummingtonite, relict pyroxene, and olivine.

ga **gn** **ms** — Gneiss and mica schist
ga: *dark-green to black garnet-hornblende schist and garnetiferous amphibolite.* gn: *muscovite and muscovite-biotite gneiss with interlayered mica schist, graphite-mica schist, and feldspathic quartzite; contains some garnet-hornblende schist.* ms: *garnet-mica schist, contains some kyanite and staurolite; has interlayered micaceous quartzite, garnet-mica gneiss, calc-gneiss, and graphitic schist layers.*

n **p€ra d** **g** — Rich Acres formation
n: *dark-gray, coarse-grained to porphyritic norite, has some ophitic texture;* d: *medium- to dark-gray, medium- to coarse-grained quartz diorite and diorite;* g: *predominantly fine- to medium-grained gabbro and hornblende metagabbro and contains some quartz diorite, diorite, and norite.*

lg **p€lw** — Leatherwood Granite
lg: *foliated leucocratic granite;* p€lw: *porphyritic granite.*

fm **fg** — Fork Mountain formation
fm: *garnetiferous chloritoid-kyanite mica schist, kyanite and sillimanite granofels, and interlayered kyanite quartzite;* fg: *coarse- to medium-grained, garnetiferous, biotite gneiss; contains some alumino-silicate rich zones and quartzite layers.*

ba **bg** — Bassett formation
ba: *gneissic to schistose dark-green to black amphibolite, contains some epidote rich layers and pyroxene granofels bodies;* bg: *medium- to fine-grained, segregation banded, leucocratic biotite gneiss, contains some minor amphibolite layers, epidote-rich zones and augen-gneiss facies adjacent to mafic intrusions.*

agn — Granitic augen gneiss
Coarse augen and flaser granitic gneiss, with anastomosing biotite schist layers, contains localized hornblende schist and gneiss layers, banded mica gneiss and foliated leucogranite.

CONTACTS

exposed
approximate
covered or inferred

FOLDS

Anticline—trace of axial plane and direction of plunge of axis
Syncline—trace of axial plane and direction of plunge of axis
Overturned anticline—trace of axial plane and direction of plunge of axis
Overturned syncline—trace of axial plane and direction of plunge of axis
Direction and angle of dip of axial plane of minor overturned anticline
15 Direction and angle of plunge of minor plunging anticline
40 Direction and angle of plunge of minor plunging syncline
30 30 Direction, angle of plunge, and angle of dip of axial plane of minor overturned plunging anticline
4 20 Direction, angle of plunge and angle of dip of axial plane of minor overturned plunging syncline

FOLIATION AND CLEAVAGE

30 Strike and dip of inclined foliation
Strike of vertical foliation
Horizontal foliation
60 Strike and dip of inclined fracture cleavage
Strike of vertical fracture cleavage
45 Strike and dip of inclined compositional banding
Strike of vertical compositional banding

LINEATIONS

10 Bearing and plunge of mineral lineation
Bearing of horizontal mineral lineation
5 Bearing and plunge of rodding, boudinage and crinkle folds
Bearing of horizontal rodding, boudinage and crinkle folds
10 Bearing, plunge, and sense of symmetry of crenulation

FAULTS

THRUST

T — overthrust side

SAMPLE LOCATIONS

△ R-4785 Location and repository number of sampled lithology

QUARRY, MINES AND PROSPECTS

Abandoned Quarry and Mines

⚒ mica (mine)
⚒gr granite (quarry)
⚒f feldspar

Prospects

X mica
Xfe magnetite
Xgn gneiss
Xmz monazite and zircon
Xq vein quartz

PEGMATITE DIKE OR SILL

— Strike of pegmatite dike or sill

COMMONWEALTH OF VIRGINIA
DEPARTMENT OF CONSERVATION AND ECONOMIC DEVELOPMENT
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James L. Calver
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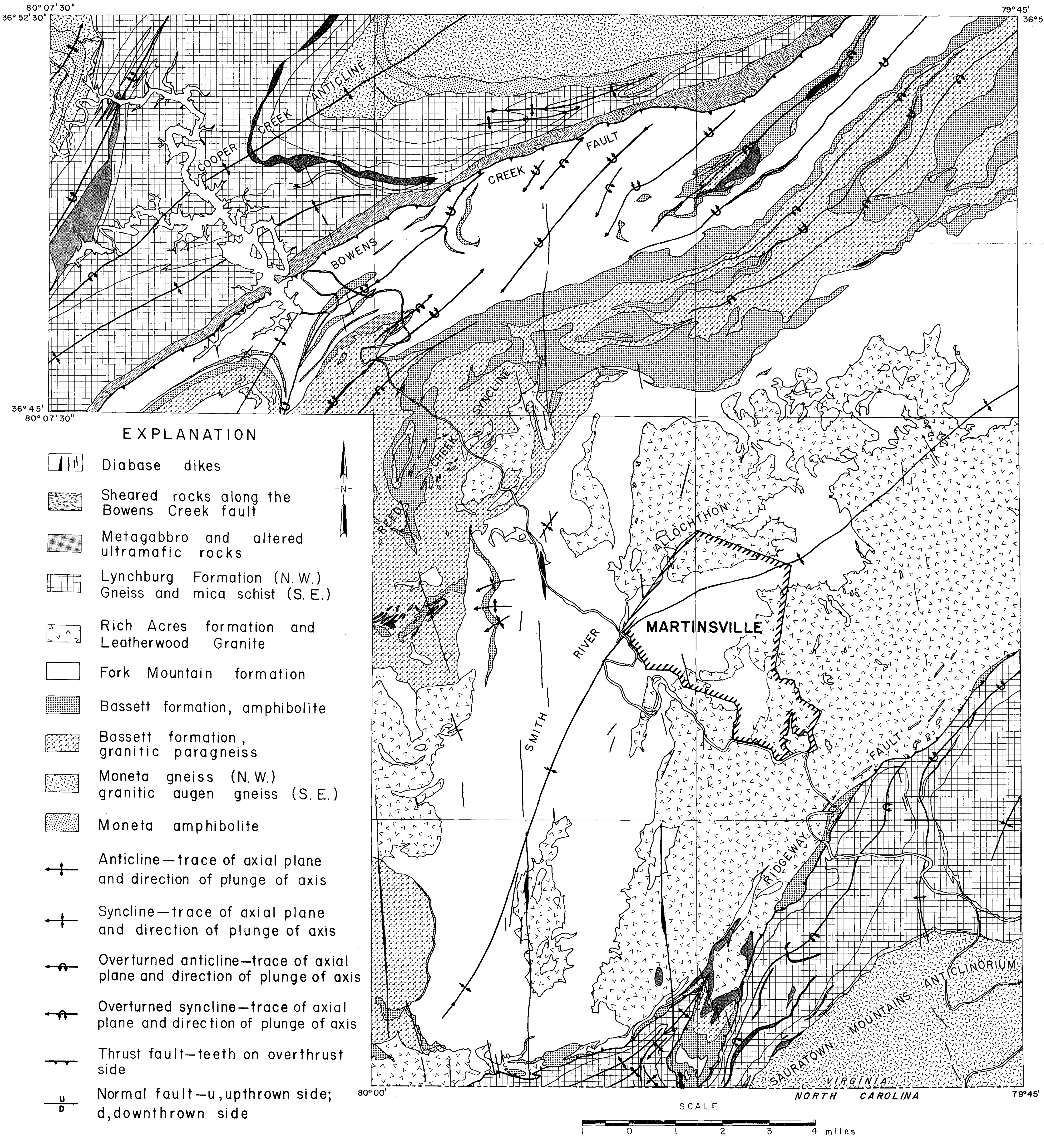
REPORT OF INVESTIGATIONS 33
PLATE 4



EXPLANATION

- Diabase dikes
- ▨ Sheared rocks along the Bowens Creek fault
- ▨ Metagabbro and altered ultramafic rocks
- ▦ Lynchburg Formation (N.W.) Gneiss and mica schist (S.E.)
- Rich Acres formation and Leatherwood Granite
- ☐ Fork Mountain formation
- ▨ Bassett formation, amphibolite
- ▨ Bassett formation, granitic paragneiss
- ▨ Moneta gneiss (N.W.) granitic augen gneiss (S.E.)
- ▨ Moneta amphibolite
- Anticline—trace of axial plane and direction of plunge of axis
- Syncline—trace of axial plane and direction of plunge of axis
- Overturned anticline—trace of axial plane and direction of plunge of axis
- Overturned syncline—trace of axial plane and direction of plunge of axis
- Thrust fault—teeth on overthrust side
- Normal fault—u, upthrown side; d, downthrown side

MAJOR ROCK UNITS AND GEOLOGIC STRUCTURES, MARTINSVILLE AREA, VIRGINIA
1973

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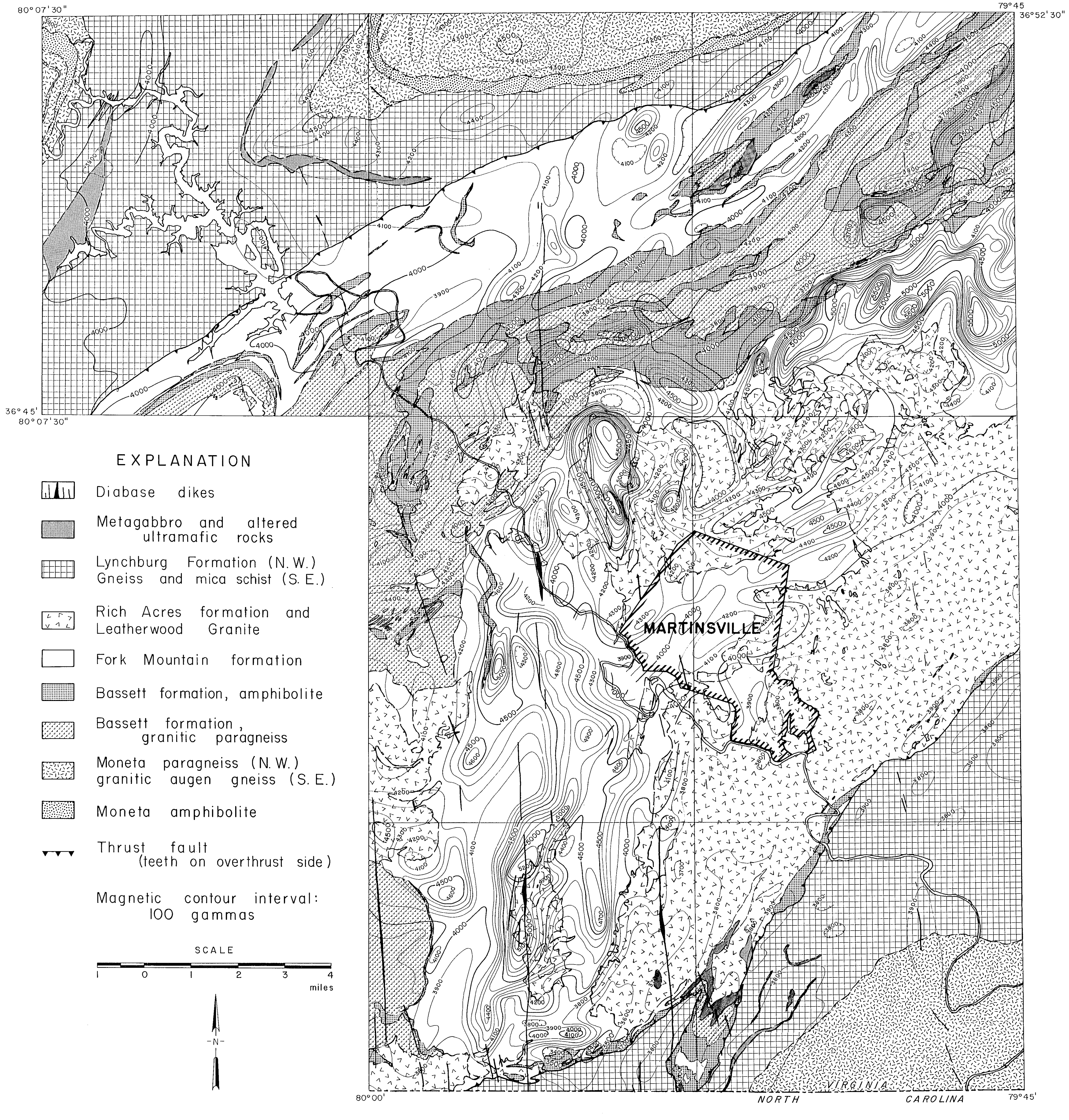
Commissioner of Mineral Resources and State Geologist



AEROMAGNETIC CONTOURS SUPERIMPOSED ON GENERALIZED GEOLOGY, MARTINSVILLE AREA, VIRGINIA
1973