U.S. DEPARTMENT OF THE INTERIOR

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Preliminary Bedrock Geologic Map of the Wightman 7.5' Quadrangle, Virginia

by

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INTRODUCTION

The Wightman 7.5' quadrangle has been mapped as part of the Geology of the South-Central Virginia Piedmont Project, where geologic mapping of adjacent areas is in progress (Horton and others, 1993). It is located in the east-central part of the South Boston 30'x60' quadrangle.

The Wightman quadrangle is within the Carolina slate belt (Figure 1) and has not been previously mapped in detail. The Carolina slate belt in this area consists of volcanic and sedimentary rocks and associated intrusive igneous rocks that have been subjected to lower greenschist-facies metamorphism. The rocks are poorly dated but of probable Late Proterozoic and Early Cambrian age (Butler and Secor, 1991). The Carolina slate belt may represent a subduction-related volcanic arc (Butler and Secor, 1991), or rifted-arc complex (Feiss and others, 1993).

LITHOLOGY

The rocks of the Wightman quadrangle consist of both stratified and intrusive rocks that have been subjected to mild deformation and lower greenschist-facies metamorphism. The stratified rocks are mostly phyllitic pyroclastic and epiclastic rocks and lesser volcanic flows of felsic to mafic composition, with felsic rocks predominant. The lithologic units within this sequence strike northeast and generally dip steeply northwest. The most distinctive and continuous units within this sequence are greenstone (**Zm**), felsic crystal metatuff (**Zxf**), and layered metavolcanic and metasedimentary rock (**Zvl**). Sedimentary tops determined from graded bedding and crossbeds at three localities in the layered metavolcanic and metasedimentary unit (**Zvl**) (shown by bedding symbol with ball) indicate north- or west-side-up; therefore the stratified rocks are inferred to young from southeast to northwest across the quadrangle. The explanation of map units follows this sequence.

The intrusive rocks range from gabbro to granite in composition with hornblende diorite-gabbro (**dg**) and biotite tonalite (**to**) predominant, particularly in the northwestern half of the quadrangle. The large diorite-gabbro body shown has been traced into the adjacent quadrangles to the west and north and extends west to the middle of the Chase City quadrangle. Consistent cross-cutting relationships demonstrate that diorite, tonalite, and biotite granite and granodiorite (**gd**) intruded in that order. Small dikes of tonalite (**T**) and aplite (**A**) that are mapped only by strike and dip symbol commonly cut diorite-gabbro (**dg**), while rare, thin mafic dikes (**M**) perhaps intruded later. Alkali-feldspar granite of the North View pluton (**gn**), first described by Farrar and Givan (1988) and studied in greater detail by Bentley (1992), is in contact with and probably intrudes the base of the exposed stratified section within the quadrangle. This granite is not in contact with the other plutonic rocks in the quadrangle, so its relative intrusive age is unknown. It may belong to the Crossnore suite of alkaline to peralkaline granites (Farrar and Givan, 1988), and is assumed here to be the youngest pre-Mesozoic intrusive rock. Thin, continuous Jurassic diabase dikes (**Jd**) cut all other rocks.

STRUCTURE AND METAMORPHISM

The rocks of the Wightman quadrangle are weakly deformed and have undergone lower-greenschist-facies metamorphism, and the stratified rocks are now steeply tilted. A regional deformation produced mild folding and a widespread, mostly northeast-striking and west-dipping penetrative cleavage during or possibly following the tilting. Strike variations in bedding and primary layering in the layered metavolcanic and metasedimentary unit (**Zvl**) outline early broad, open folds. A foliation in diorite-gabbro (**dg**) and tonalite (**to**), caused by the alignment of hornblende and biotite, respectively, is believed to be a primary igneous flow structure that may have been mildly warped by the deformation. In most of the phyllitic units outcrop-scale primary depositional structures have been obliterated by the cleavage; however, the contacts bounding these units are primarily linear, northeast-striking, and mainly subparallel to regional cleavage. Later, local minor crenulations and kink folds in cleavage have axial planes at moderate to high angles to the regional cleavage trend; the tectonic significance of these late-stage folds is undetermined and they do not appear to appreciably affect the map pattern. Outcrop-scale shear or mylonite zones are uncommon and no continuous faults were mapped; therefore faulting and simple shear probably played minor roles in the regional deformation. The regional cleavage probably formed mainly under conditions of shortening and pure shear in the manner shown by an outcrop in the Chase City quadrangle of fine-grained felsite (**Zf**) with folded quartz veins (Figure 2A), and by strongly flattened clasts in volcanic breccia in the Wightman quadrangle (**Zpv**) (Figure 2B). Absence of more than one metamorphic foliation suggests a relatively simple history of deformation.

The regional metamorphism that accompanied deformation was of the lower greenschist facies. Typical secondary minerals include white mica in felsic rocks, and biotite, chlorite, and epidote in mafic rocks, with the micaceous minerals growing parallel to cleavage. Hornblende has been altered to pale green or blue-green amphibole and pyroxene thoroughly uralitized. No metamorphic garnet has been found in the Wightman quadrangle. Chloritoid was found in one outcrop of fine-grained felsite (**Zf**), indicating low grade metamorphism. Lack of evidence for multiple episodes of recrystallization supports the structural evidence for a relatively simple tectonic history for the area mapped.

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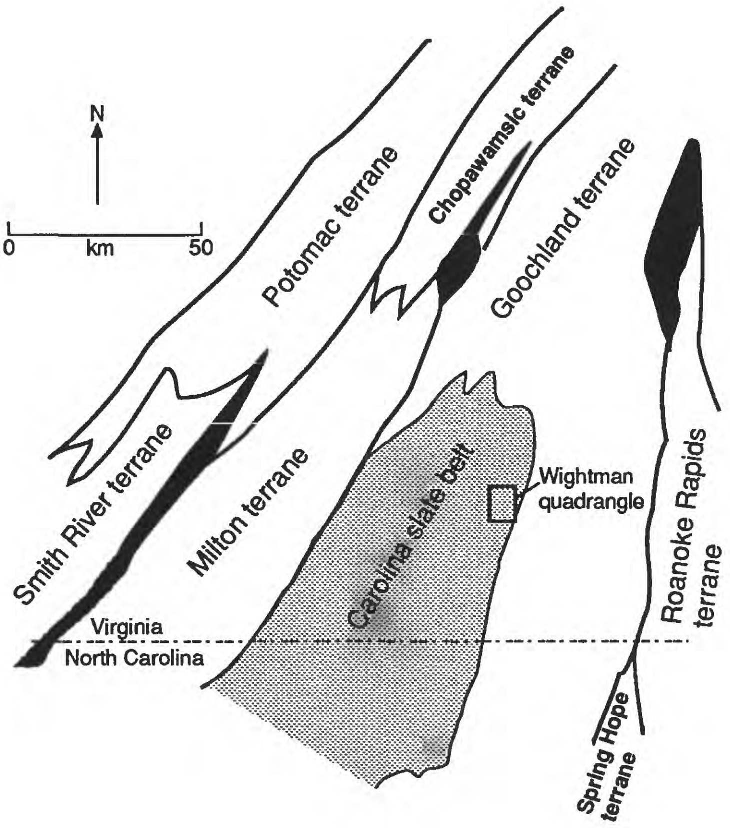


Figure 1. Location of map area with respect to Carolina slate belt and other geologic terranes of the Piedmont (labeled) and early Mesozoic basins (black). After Horton and others (1991).

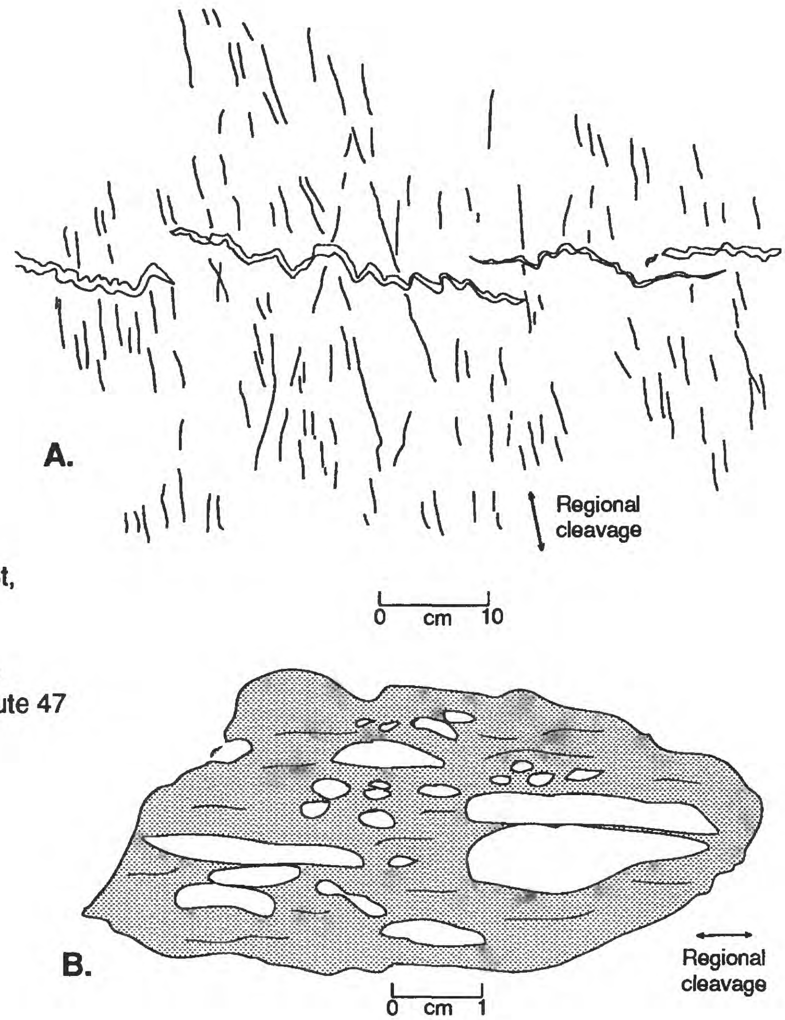


Figure 2. Evidence for compression and shortening in vicinity of map area.
A: Folded quartz veins in outcrop of weakly to moderately cleaved fine-grained felsite in Chase City quadrangle. Amount of shortening shown is about 15 percent, which must be a minimum since the quartz veins are not primary structures.
B: Traced slab showing flattened pumice clasts in sample of volcanic breccia, north of State Route 47 near western edge of Wightman quadrangle

DESCRIPTION OF MAP UNITS

Early Mesozoic intrusive rock

Jd Diabase (Early Jurassic)--Dark gray, medium- to fine-grained diabase in narrow dikes; consists of subequal amounts of plagioclase and clinopyroxene (augite), plus altered olivine

Intrusive rocks of probable Late Proterozoic or Early Paleozoic age

gn Granite of North View pluton--Buff to gray, massive to weakly foliated, medium-grained biotite alkali feldspar granite. Rock contains about 50% weakly perthitic and nonperthitic microcline, plus quartz and lesser plagioclase, and minor (<5%) magnetite, hematite, biotite, and blue green amphibole (riebeckite)

gd Biotite granite and granodiorite--Gray to orange-gray-weathering, massive, medium to fine-grained, white to pinkish-white biotite granite and granodiorite containing subequal amounts of quartz and plagioclase, nonperthitic microcline (15-35%), and minor (<10%) biotite, sericite, epidote, and chlorite

to Biotite tonalite--Gray to orange-gray-weathering, massive, medium to fine-grained white biotite tonalite containing subequal amounts of plagioclase and quartz, 10-15% biotite, and minor potassium feldspar, sericite, chlorite, epidote, sphene, and oxide

dg Hornblende diorite and gabbro--Mottled dark green, massive to locally foliated, medium to coarse-grained hornblende diorite, hornblende quartz diorite, and minor hornblende-pyroxene gabbro. In diorite, original mineralogy consisted of about 40% mafic minerals, including hornblende and lesser biotite and 60% plagioclase and minor quartz; now partially altered to blue-green amphibole, chlorite, epidote, and sericite. Quartz content typically 5-10% and biotite content 0-10%. In gabbro, pyroxene originally constituted about 50% of rock, particularly in cumulate zones (stippled pattern); now completely altered to amphibole

Metasedimentary and metavolcanic rocks of probable Late Proterozoic age (minerals listed in increasing order)

Zvl

Layered metavolcanic and metasedimentary rocks--Fine grained, buff to dark gray-weathering, finely bedded to well-layered metasiltstone and metatuff. Primary structures include faint, fine bedding laminae and cross-beds in metasiltstone and conspicuous, light and dark, mm- to cm-scale compositional layering in metatuff. Minerals include, in varying abundances, quartz, albite, sericite, biotite, chlorite, and epidote; compositional layering caused by changing abundances of quartzofeldspathic vs. ferromagnesian minerals

Zpv

Phyllitic volcaniclastic rock and mudflow breccia--Bluish-gray-weathering, fine-grained, quartz-albite-sericite-chlorite-epidote phyllite with relict plagioclase phenocrysts and flattened pumice clasts 1 to 5 mm in length, and minor, gray-weathering, unfoliated mudflow breccia consisting of poorly-sorted, matrix-supported angular to subrounded clasts as much as 5 cm in length of felsic to intermediate chlorite-biotite-sericite-epidote-albite metavolcanic rock

Zxf

Felsic crystal metatuff--Light-gray, weakly to moderately foliated felsic metatuff with abundant, conspicuous phenocrysts 2-5 mm in length of quartz and plagioclase in groundmass of very fine-grained allotriomorphic-granular quartz and potassium feldspar. Foliation where present consists of sericite and recrystallized quartz and feldspar

Zf

Fine-grained felsite--White, fine-grained, well-cleaved epidote-albite-quartz-sericite phyllite, with 0-30% potassium feldspar, interpreted as rhyolitic or dacitic metatuff. Locally contains medium-fine-grained (1-2 mm) relict phenocrysts of plagioclase and quartz

Zm

Greenstone--Dark green, fine-grained, massive to weakly foliated, locally amydaloidal, albite-epidote-chlorite greenstone (metabasalt), and dark-green, well-foliated albite-epidote-chlorite phyllite interpreted as metabasalt or possibly basaltic metatuff

Zph

Mixed phyllite--White to bluish-green albite-quartz-sericite phyllite and epidote-albite-sericite-chlorite phyllite, interlayered on a scale of meters and probably derived from intercalated tuffs or volcanogenic sediments

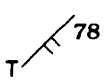
Zq

Quartz rock--White, fine-grained, sugary-textured vein quartz and possible quartzite, and lesser coarsely-crystalline vein quartz. Locally contains rounded to angular cm-scale quartz lumps or clasts and thin, phyllitic stringers or interlayers consisting of fine-grained sericite

EXPLANATION OF MAP SYMBOLS

Contact--Solid where accurately known, dashed where approximate

Strike and dip of intrusive dike contact--Exposed contact of dike with mafic (M), tonalitic (T), or uncertain felsic (A) composition



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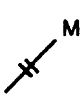

vertical

Strike and dip of bedding--Fine bedding laminae or compositional contact in layered rocks (**Zvl**); ball indicates facing direction, where known

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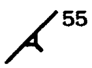
Strike and dip of compositional layering--Light and dark banding in metatuffs (**Zvl**) interpreted as primary compositional layering



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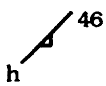
Strike and dip of flow foliation in plutonic rocks--Crude alignment of hornblende (h) in diorite-gabbro (**dg**) and biotite (b) in tonalite (**to**) interpreted as primary igneous flow foliation



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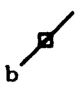

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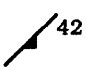
Strike and dip of regional, penetrative cleavage or schistosity



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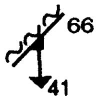
Strike and dip of shear foliation--Mylonitic or shear foliation parallel to regional schistosity; arrow, when present, indicates trend and plunge of streaking or rodding on shear surface



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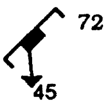
vertical

Strike and dip of axial surface of kink fold--Late crenulation or kink fold deforming regional schistosity; arrow, when present, indicates trend and plunge of hinge line



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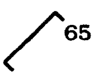
vertical

Strike and dip of joint



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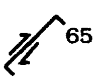
vertical

Strike and dip of small fault; arrows indicate apparent movement sense shown



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