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GEOLOGIC MAP OF THE FALLS LAKE-WAKE FOREST AREA, NORTH-CENTRAL NORTH CAROLINA

by

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INTRODUCTION

The purpose of this preliminary map is to make geologic information available to users while awaiting publication of a U.S. Geological Survey Miscellaneous Investigations Series map now in preparation. That map will meet more rigorous standards, will include additional features such as cross sections, and will show many more structure symbols than the representative selection of strike and dip measurements shown here.

The map area in Wake, Franklin, Granville, and Durham Counties, N.C., includes all of the Bayleaf and Wake Forest 7.5-minute quadrangles and parts of the Creedmoor, Franklinton, Grissom, Rolesville, and Southeast Durham 7.5-minute quadrangles. This mapping forms a 1:24,000-scale transect across the western flank of the Raleigh metamorphic belt from the Rolesville batholith on the east to the Durham sub-basin of the Deep River Triassic basin on the west. Recognition of the Falls Lake melange (Horton and others, 1986) was an earlier result of this mapping, and the melange is shown here in considerable detail.

The Raleigh gneiss (informal name of Farrar, 1985) lies adjacent to the Rolesville batholith on the east side of the map. It is variably migmatitic, and in this area is mainly a heterogeneous gneiss (rgn) composed of interlayered biotite gneiss and hornblende-biotite gneiss. These rocks are part of the Raleigh terrane of Stoddard and others (1991), which may be a southern extension of the Goochland terrane as proposed by Farrar (1985). The Raleigh gneiss contains bodies of granitic orthogneiss (Pzgg) such as the Wake Forest and Greshams Lake plutons, and is intruded by massive to foliated granites of Pennsylvanian age. The latter include biotite granite (Pgr) of the Rolesville batholith and muscovite-biotite granite (Pgw) of the Wyatt pluton.

The Raleigh gneiss is bounded on the west by the north-northeast-striking, steeply southeast-dipping Nutbush Creek fault zone. This major ductile fault zone of the Eastern Piedmont fault system shows good evidence of late Paleozoic dextral strike-slip movement (Druhan and others, 1988). Earlier movement along this segment, although permissible, is unconfirmed. Detailed mapping presented here supersedes earlier reconnaissance (Farrar, 1985) which located the Nutbush Creek fault zone several kilometers farther west. The Nutbush Creek fault zone in this area is largely occupied by a tabular, highly elongate sheet of subhorizontally lineated, granitic orthogneiss (SOgf) informally known as the "Falls leucogneiss" (Farrar, 1985) or "Falls lineated gneiss" (Mims and others, 1990). The eastern limit of this lineated granitic orthogneiss, and of the Nutbush Creek fault zone, is east of that shown by Mims and others (1990, Fig. 2), such that their "Raleigh belt gneiss" samples collected along the Neuse River are within the Falls leucogneiss as delineated on this map.

Farther west, a metamorphic suite described by Horton and others (1989) as part of the Crabtree terrane is exposed in the core of the Raleigh antiform and in the Purnell area farther north. This metamorphic suite contains the felsic gneiss of Crabtree Creek (cf), the garnet-kyanite schist of Horse Creek (cgk), and distinct marker units of graphitic schist (cgs). The metamorphic suite is structurally overlain (along the Falls Lake thrust fault) by the Falls Lake

melange (Horton and others, 1986). This melange is predominantly biotite-muscovite schist (€Zfs) containing lenses and pods of amphibolite (€Zfa) and several types of ultramafic rock. The Falls Lake thrust fault and juxtaposed units wrap around the north-plunging Raleigh antiform and are truncated on the east by the Nutbush Creek fault zone. This map encompasses the southern termination of the Falls Lake melange, indicating that the melange does not extend farther south along the western limb of the Raleigh antiform as formerly proposed (Horton and others, 1986). On the eastern limb of the Raleigh antiform, the melange extends about 3.5 kilometers south-southwest of the limit suggested by Wylie's (1984) initial reconnaissance.

A sharp contact separates the Falls Lake melange from Late Proterozoic to Cambrian (?) rocks of the Carolina slate belt on the western side of the map, and mylonitic textures suggest that this contact is a fault. The eastern flank of the Carolina slate belt in this area includes the Cary formation (informal name of Farrar, 1985), intrusive rocks of the Beaverdam diorite-gabbro complex (informal name of Parker, 1979), and small bodies of metatonalite, metadiorite, and metagabbro. In this area, the Cary formation (equivalent to the informal "Cary sequence" of Parker, 1979) consists of phyllitic to almost massive, felsic metavolcanic rock (€Zcf) and interlayered metasedimentary units. The steeply northwest-dipping Jonesboro fault separates moderately northwest-dipping rocks of the Beaverdam diorite-gabbro complex and Cary formation from gently southeast-dipping units of Upper Triassic conglomerate, sandstone, and siltstone of the Chatham Group in the Durham subbasin on the western side of the map. Jurassic diabase dikes strike north and northwest, cutting across the older units.

Patches of upland sand and gravel (Ts) on drainage divides near Leesville and Purnell may represent the westernmost outliers of Atlantic Coastal Plain strata in this region of the Piedmont. Other surficial units include alluvial terrace deposits (Qt) along the Neuse River and alluvium on flood plains (Qal).

Field work for this map was conducted by J. Wright Horton, Jr., 1984-1991; David E. Blake, 1985-1986; Albert S. Wylie, Jr., 1981-1982; and Edward F. Stoddard, 1986-1989. Blake's (1986) M.S. thesis at North Carolina State University was sponsored and partly supported by the U.S. Geological Survey as part of this mapping project. Other preliminary results are contained in Wylie (1984), Horton and others (1986), and Stoddard and others (1986).

DESCRIPTION OF MAP UNITS

af — **Artificial fill**--Various materials occupying low-lying areas filled for construction of highways, bridges, railroad beds, and dams

Qal — **Alluvium (Holocene)**--Unconsolidated sand, gravel, silt, and clay underlying sinuous flood plains along most streams

Qt — **Terrace deposits (Quaternary?)**--Unconsolidated alluvial deposits of sand, gravel, silt, and clay higher than present flood plain along Neuse River

Ts — **Upland sand and gravel (Pliocene?)**--Poorly-sorted pebbly quartz sand, sandy gravel, and sandy red clay containing rounded pebbles of essentially all quartz. Generally unconsolidated but locally stained and partly cemented by limonite. Thickness ranges from less than a meter to about 3 meters; only deposits thicker than one meter are shown. Includes fluvial(?) deposits as well as lag gravel and colluvium derived from those deposits. Occurs as patches on the highest drainage divides (elevation 500-560 feet) near Leesville and Purnell, although colluvium extends to lower elevations.

Jd — **Olivine diabase (Early Jurassic)**--Dark gray to black, fine- to medium-grained; occurs as steeply dipping dikes

DURHAM SUB-BASIN OF DEEP RIVER TRIASSIC BASIN

Chatham Group (Late Triassic)--Part of Newark Supergroup. Units Trcc, Trcs/c, Trcsc, and Trcs on eastern margin of rift basin are collectively equivalent to Hoffman and Gallagher's (1989) "Lithofacies Association III," and are interpreted as alluvial fan deposits. Unit Trcs/si (in central area of rift basin) is part of their "Lithofacies Association II" and is interpreted as fluvial in origin.

Trcc — **Conglomerate**--Massive to thickly bedded, predominantly clast supported conglomerate composed of rounded cobbles and boulders of variably mixed, locally-derived crystalline rock in a reddish-brown matrix of poorly-sorted, silty to pebbly, lithic, feldspathic sandstone

Trcs/c — **Sandstone containing interbedded conglomerate**--reddish-brown, coarse grained to pebbly, poorly sorted, lithic, feldspathic sandstone containing subordinate (< 50%) beds of pebble to cobble conglomerate

Trcsc — **Pebbly sandstone**--reddish brown, poorly sorted, matrix-supported feldspathic litharenite to lithic arkose containing more than 5% matrix-

supported granules and pebbles of crystalline rock. Local conglomerate interbeds, where present, are minor and discontinuous

Trcs **Sandstone**--reddish brown, poorly to moderately sorted, very fine- to medium-grained, variably silty, arkose and lithic arkose; lack of muscovite distinguishes this sandstone from similar sandstones in Trcs/si

Trcs/si **Sandstone and interbedded siltstone**--Mainly grayish-pink to pale red, medium- to coarse-grained arkose grading upward into fine-grained arkose and reddish-brown, bioturbated siltstone; fining-upward sequences are 2-5 meters thick. Pink K-feldspar is abundant, and the presence of muscovite distinguishes these sandstones from those in Trcs. Interpreted by Hoffman and Gallagher (1989) as meandering stream deposits

FAULT ROCKS

sc **Siliceous cataclasite (Triassic)**--Occurs along Jonesboro fault

my **Mylonite and mylonite gneiss**--Recrystallized mylonite and thinly banded "ribbon" gneiss along Falls Lake thrust

PALEOZOIC INTRUSIVE ROCKS

Pgw **Muscovite-biotite granite of Wyatt pluton (Pennsylvanian)**--Very light gray, medium-grained, muscovite-biotite monzogranite and pinkish-gray, medium- to coarse-grained, muscovite-biotite monzogranite. Presence of muscovite (less abundant than biotite) and accessory garnet are distinctive. Granite is foliated, and inclusions of Raleigh gneiss are common

Pgr **Biotite monzogranite of Rolesville batholith (Pennsylvanian)**--Medium- to coarse-grained, massive to weakly foliated biotite monzogranite composed of perthitic microcline, oligoclase (commonly with albite rims), quartz, and minor biotite. Primary and secondary accessories include opaque minerals, allanite, titanite, apatite, zircon, chlorite, epidote, muscovite, calcite, and hematite. Equivalent to "Rolesville main facies" of Farrar (1985)

Pzgg **Gneissic biotite granitoid (Paleozoic?)**--Foliated biotite granitoid and granitoid orthogneiss interlayered with Raleigh gneiss. Includes Wake Forest pluton and Greshams Lake pluton

SOgf **Falls leucogneiss (Silurian or Ordovician?)**--Strongly lineated granitic orthogneiss containing abundant accessory magnetite; interpreted to occupy Nutbush Creek fault zone. Informally named by Farrar (1985)

Beaverdam diorite-gabbro complex (informal name of Parker, 1979) and related diorite-gabbro plutons

€Zdi **Metadiorite (Cambrian and (or) Late Proterozoic?)**--Metamorphosed biotite- and hornblende-biotite diorite to quartz diorite

€Zgb **Metagabbro (Cambrian and (or) Late Proterozoic?)**--Metamorphosed hornblende gabbro

€Zto **Metatonalite (Cambrian and (or) Late Proterozoic?)**--Metamorphosed biotite tonalite

VOLCANOGENIC TERRANE OF CAROLINA SLATE BELT

Cary formation (informal name of Farrar, 1985; equivalent in this area to "Cary sequence" of Parker, 1979)

€Zcf **Felsic metavolcanic rock and phyllitic metasiltstone (Cambrian and (or) Late Proterozoic?)**--Generally fine-grained, almost massive to phyllitic, mainly dacitic metavolcanic rock, and fine-grained phyllitic metasiltstone composed mostly of quartz, muscovite, and plagioclase.

€Zcm **Ilmenite-magnetite quartzite (Cambrian and (or) Late Proterozoic?)**--Occurs near U.S. Highway 70 entrance to Umstead State Park

€Zcc **Phyllitic conglomerate (Cambrian and (or) Late Proterozoic?)**--Phyllitic quartz-pebble conglomerate and pebbly phyllite containing rounded to well-rounded, fine to medium pebbles of quartz or quartzite. Occurs in Umstead State Park

CRABTREE TERRANE
[Ages of rocks undetermined]

cf **Felsic gneiss of Crabtree Creek**--Very light-gray to pinkish-gray, weakly layered and well foliated. Composed of quartz (50-80%), oligoclase (10-35%), microcline (0-10%), and muscovite (0-15%), with accessory biotite, chlorite, and epidote. Includes "quartz-disk gneiss" of Parker (1979). Interpretations range from plutonic (Kish and Campbell, 1986) to meta-arkose (Parker, 1979). High quartz content, local quartz disks (flattened pebbles?), and interlayered

aluminous and graphitic schists (cgk and cgs) suggest metasedimentary or metavolcanic origin. Chemical and isotopic data (Kish and Campbell, 1986) are compatible with a volcanic interpretation

cgk **Garnet-kyanite schist of Horse Creek**--Coarse-grained aluminous schist having abundant, conspicuous porphyroblasts of kyanite and garnet. Composed of quartz, muscovite, biotite, garnet, kyanite, and minor amounts of staurolite and albite. Accessories include apatite, zircon, and opaque minerals. Staurolite occurs as small anhedral grains and as inclusions in garnet

cgs **Graphitic schist**--Gray to black schist composed mainly of quartz, graphite, and muscovite; porphyroblasts of garnet and staurolite are common. Other constituents include biotite, albite, opaque minerals, and locally kyanite

cmq **Muscovite-quartz schist**--Very light gray and commonly feldspathic

cam **Hornblende gneiss and amphibolite**

cfs **Interlayered felsic gneiss and biotite-muscovite schist**--Occurrence adjacent to Falls Lake thrust fault suggests that interlayering may be tectonic

FALLS LAKE MELANGE

Predominantly biotite-muscovite schist (€Zfs) matrix containing discontinuous lenses and pods of amphibolite (€Zfa) and ultramafic rocks (€Zfua, €Zfus, €Zfut, €Zfu) ranging from pebble-size to mappable dimensions. Blocks shown are limited by exposure and others are likely present. Ages of blocks and matrix are undetermined, and their age assignment (Cambrian and (or) Late Proterozoic?) is tentative.

€Zfs **Biotite-muscovite schist (Cambrian and (or) Late Proterozoic?)**--Biotite-muscovite-oligoclase-quartz schist; minor chlorite and garnet are common; accessory staurolite and kyanite are locally present

€Zfua **Actinolite rock and actinolite-chlorite schist (Cambrian and (or) Late Proterozoic?)**--Dark-green, schistose to almost massive, splintery rock composed of actinolite and varied amounts of chlorite; minor amounts of talc and magnetite octahedra are common. Some blocks have green, actinolite-rich cores and more hydrous, chlorite-rich rims.

€Zfut **Talcose schist (Cambrian and (or) Late Proterozoic?)**--Talc-tremolite schist, talc-chlorite schist, and soapstone. Rhombohedral cavities suggest former presence of a carbonate mineral (ankerite?); clinopyroxene is a rare accessory

-€Zfus **Serpentinite (Cambrian and (or) Late Proterozoic?)**--Greenish gray to white, fine-grained, and massive; contains thin streaks of magnetite as well as fibrous tremolite, and less commonly olivine and chromite

-€Zfu **Ultramafic rocks (undivided) (Cambrian and (or) Late Proterozoic?)**--Variably altered ultramafic rocks including -€Zfua, -€Zfut, and -€Zfus

-€Zfa **Amphibolite (Cambrian and (or) Late Proterozoic?)**--Dark gray, fine- to medium grained, and well foliated

-€Zfqz **Quartzite (Cambrian and (or) Late Proterozoic?)**--White, granular, and well foliated

-€Zfq **Siliceous rock (Cambrian and (or) Late Proterozoic?)**--Mainly chalcedony with drusy quartz crystals; occurs in serpentinite at crest of Adam Mountain

-€Zfp **Pebbly paragneiss and schist (Cambrian and (or) Late Proterozoic?)**--Biotite-muscovite-oligoclase-quartz paragneiss and schist containing rounded granitoid pebbles. Pebbles are matrix supported and typically sparse. Interpreted as metamorphosed pebbly mudstone or graywacke

RALEIGH (GOOCHLAND?) TERRANE

Raleigh gneiss (Late Proterozoic or Middle Proterozoic?)--Heterogeneous gneisses, well banded and variably migmatitic; leucosomes and crisscrossing dikes of granite, pegmatite, and aplite are widespread. Named informally by Farrar (1985); equivalent to "injected gneiss and schist" of Parker (1979). Age is poorly constrained

rgn **Heterogeneous gneiss**--Interlayered biotite gneiss (rb) and hornblende gneiss (rh), commonly with layers of amphibolite

rb **Biotite gneiss**--Biotite-plagioclase-quartz gneiss, well banded and variably migmatitic

rh **Hornblende-biotite gneiss**--Hornblende-biotite-plagioclase-quartz gneiss, well-banded and variably migmatitic. Titanite is common and locally abundant

rl **Fine-grained leucocratic gneiss**--Very light gray, fine-grained, leucocratic epidote-plagioclase-quartz gneiss, locally containing darker, hornblende-bearing interlayers. Composition suggests volcanic origin

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