GEOLOGIC MAP OF THE RALEIGH WEST 7.5-MINUTE QUADRANGLE, WAKE COUNTY, NORTH CAROLINA

This geologic map was funded in part by the USGS National Cooperative Geologic Mapping Program

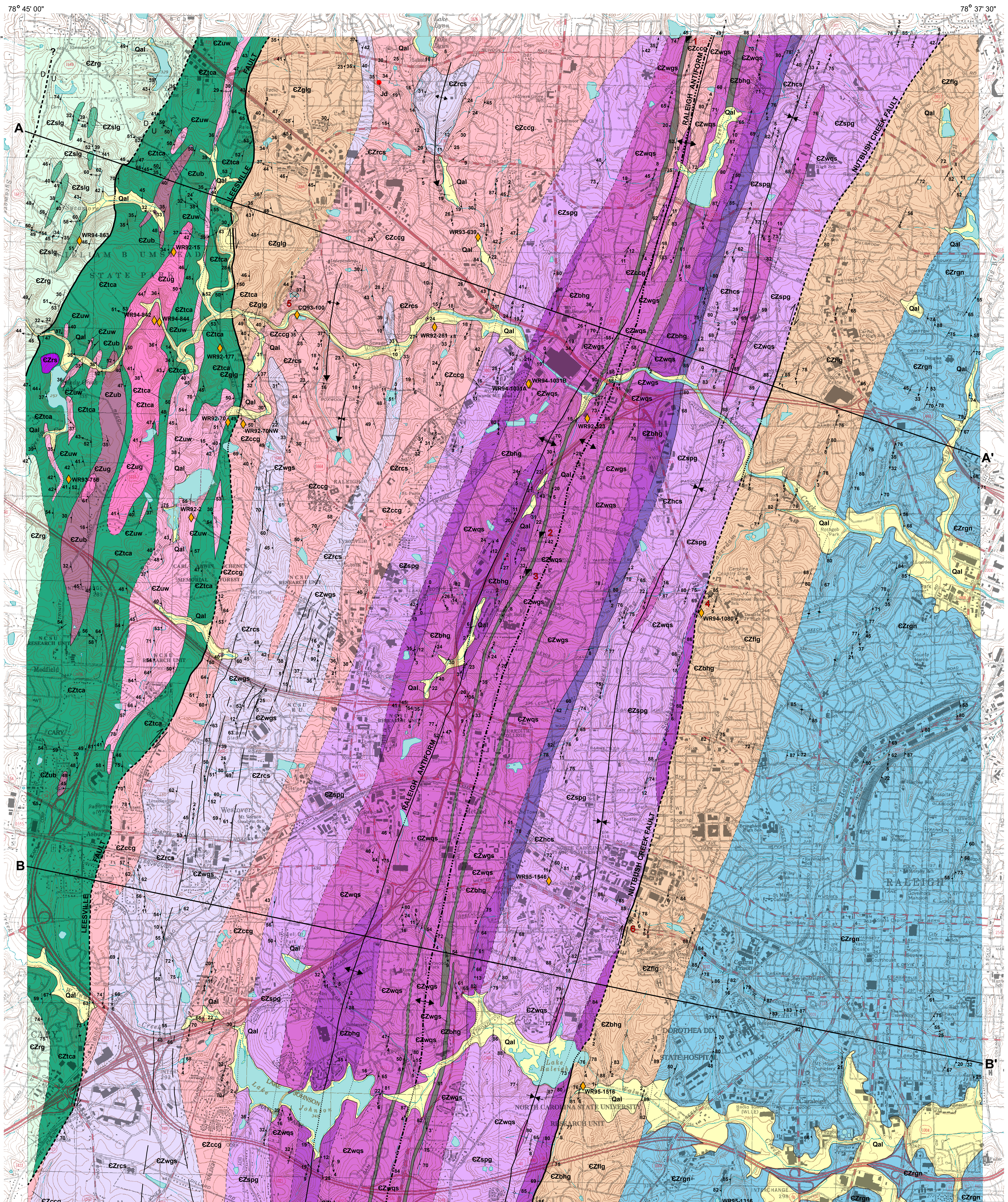
DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
DIVISION OF LAND RESOURCES
JAMES D. SIMONS, STATE GEOLOGIST

NORTH CAROLINA GEOLOGICAL SURVEY
GEOLOGIC MAP SERIES 15

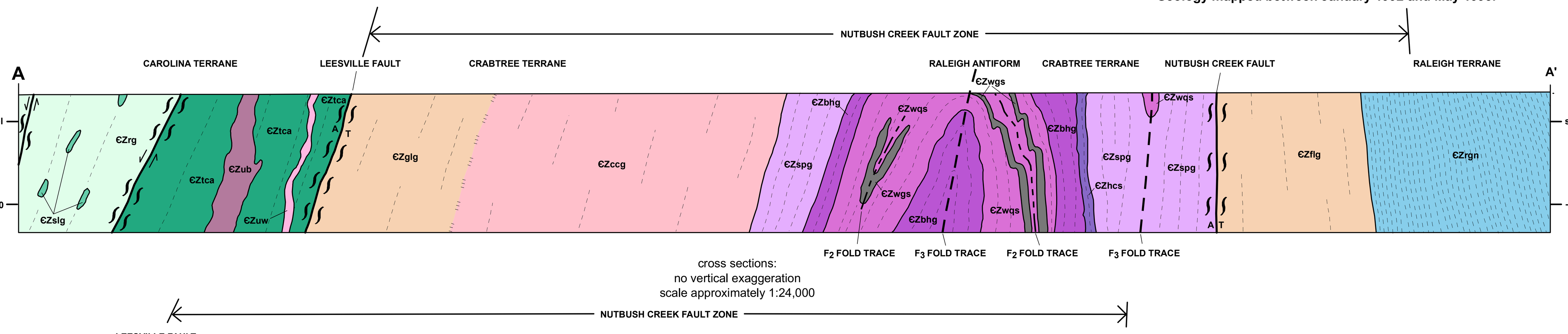
BY DAVID E. BLAKE

Digital representation by Michael A. Medina

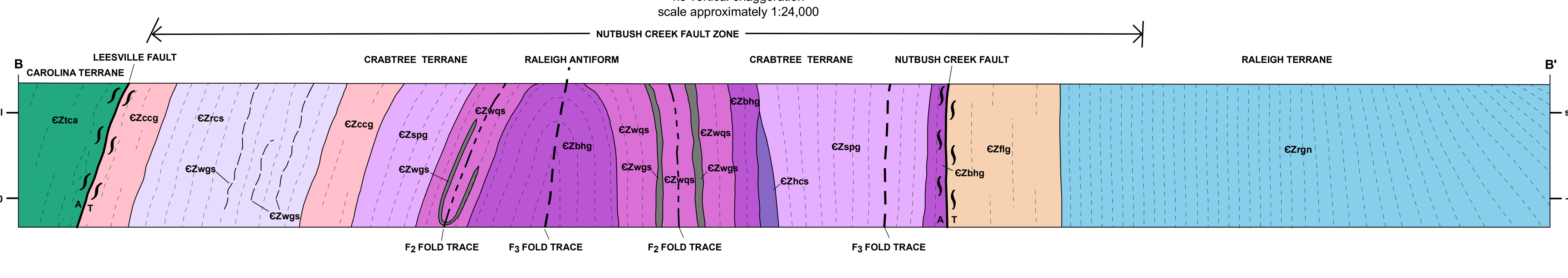
2008

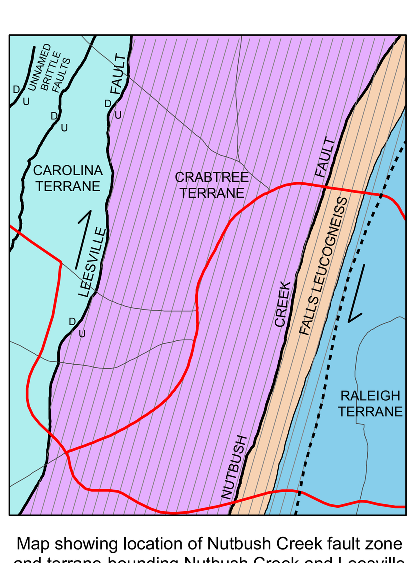


Geology mapped between January 1992 and May 1995.



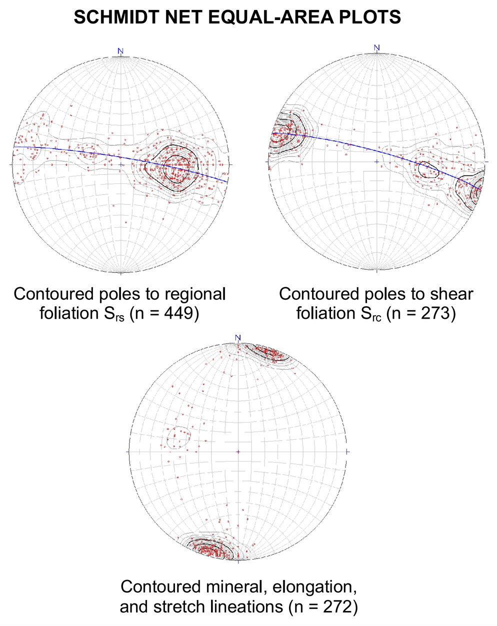
cross sections:
no vertical exaggeration
scale approximately 1:24,000





Map showing location of Nutbush Creek fault zone and terrane-bounding Nutbush Creek and Leesville faults. Hatch area indicates approximate overprint of Nutbush Creek fault zone deformation.

SCHMIDT NET EQUAL-AREA PLOTS



Contoured poles to regional foliation S_R (n = 449)

Contoured poles to shear foliation S_C (n = 273)

Contoured mineral, elongation, and stretch lineations (n = 272)

WHOLE-ROCK MAJOR AND TRACE ELEMENT COMPOSITIONS

SAMPLE ID	Unit Name	Map Unit	SiO2	TiO2	Al2O3	Fe2O3	MnO	MgO	CaO	Na2O	K2O	P2O5	Cr2O3	LOI	TOTAL	Ba	Ce	Co	Cs	Nd	Ni	Sc	Sr	Ta	Y	Zn	Zr
CQ93-100	Crabtree Creek gneiss	ЄZccg	[illegible]																								

Powder material processing conducted at the Petrology Preparation Laboratory of the Department of Geography and Geology at the University of North Carolina Wilmington.
Geochemical analyses completed by SGS Minerals, Toronto, Canada for 11 major and 49 trace elements.
NA = No sample analysis
PPM = parts per million
LOI = loss on ignition

The electronic files of the geochemical data are available upon request from the North Carolina Geological Survey.

Description of Map Units

The majority of pre-Mesozoic rocks in the Raleigh West Quadrangle have been metamorphosed from the chlorite zone of the upper greenschist facies to the staurolite-kyanite zone of the amphibolite facies during late Paleozoic contractional tectonothermal activity and early Mesozoic rifting. Only late Paleozoic pegmatitic and xenomorphic to subidiomorphic granite sills and dikes and Jurassic diabase are unmetamorphosed. Although subjected to low-grade metamorphism, rocks of the easternmost Carolina terrane (Cary sequence, Parker 1979; Hibbard et al., 2002) are locally foliated or cataclastically deformed during normal faulting; they preserve relict plutonic and volcanic textures that allow for protolith identification. As a result of medium-grade metamorphism and ductile dextral faulting, rocks of the Crabtree and Raleigh terranes are variably foliated and lineated to the extent that structural transposition obscures many protolith relationships. Locally, bulk rock compositions, relict textures, and metamorphic mineral assemblages indicate igneous and sedimentary origins for these rocks. In other exposures, partitioned high strain produces mylonitic, ultramylonitic, and phyllonitic rocks of uncertain protolith affinity.

Metaigneous rocks in all terranes are classified and named using the nomenclature of the International Union of Geological Sciences (IUGS) subcommission on the systematics of igneous rocks after Le Maitre (2002). Relict igneous textures, modal mineral assemblages, or normalized mineral assemblages when whole-rock major element geochemical data are available, provide the basis for naming metaigneous lithodemes. A preliminary lithodemic designation is developed here following Articles 31-42 of the North American Stratigraphic Code. Rock units that lack geochronologic data and stratigraphic facing directions, warrant such a designation. Past maps and lithologic descriptions of Fortson (1958), Parker (1979), and Farrar (1985a, b) in the Raleigh West Quadrangle assisted the development of the current mapping results. Detailed descriptions of some lithodemic units are reported in Blake (1994), Lumpkin et al. (1994), Stoddard and Blake (1994), and Blake et al. (2001).

Sedimentary Units

Qal Qal - Alluvium: Tan to light gray, unconsolidated, poorly sorted and stratified deposits of angular to subrounded gravel, sand, silt, and clay in stream drainages. Includes point bars, terraces, and natural levees along larger creek floodplains. Foliation measurements represent mesoscale crystalline basement inliers surrounded by alluvium too small to map separately.

Intrusive Units

Jd Jd – Diabase: Dark green-black to gray-black, plagioclase and augite aphyric to locally plagioclase phyric diabase that is locally olivine-bearing. Weathers to tan-gray, spheroidally rounded, dense boulders and cobbles or punky cobbles and pebbles that can be traced along strike where outcrop is absent. Red station locations indicate isolated outcrop or boulder fields of diabase.

Easternmost Carolina Terrane

Metaintrusive Units

ЄZrg ЄZrg – Reedy Creek metagranodiorite: Leucocratic (CI<10), light tan-gray white, bluish-gray white, or pinkish-white, medium-grained, and locally containing porphyritic 2-4 mm blue quartz phenocrysts. Boulder fields and massive outcrops are xenomorphic to subidiomorphic metagranodiorite or foliated and lineated, mylonitic granodioritic gneiss. Aggregates of white mica, quartz, plagioclase, and orthoclase highlight the mineral lineation. Locally contains subidiomorphic biotite plates and isolated clots of epidote and biotite, and is white mica-rich in gneissic layers. Contains enclaves of Sycamore Lake greenstone and microdiorite, and is crosscut by fine-grained aplitic dikes.

Umstead Metaintrusive Suite

ЄZuw ЄZuw – White mica leucogranitic gneiss: Leucocratic (CI<5), light tan to tan-white and medium- to coarse-grained, well foliated granoblastic gneiss that forms boulder fields and massive outcrops. White mica is the dominant phyllosilicate, but locally sparse biotite highlights the foliation. Locally preserves relict plutonic textures and is crosscut by fine-grained aplitic dikes.

ЄZug ЄZug – Biotite metagranite: Leucocratic (CI<10), light tan to pink, medium-grained and locally porphyritic rocks, having biotite plates and 2-4 mm blue quartz phenocrysts. Boulder fields and massive outcrops are xenomorphic to subidiomorphic biotite metagranite, and minor metadiorite and metagabbro that are locally weakly to moderately foliated and crosscut by fine-grained aplitic dikes (see Stop 5 in Blake et al., 2001).

ЄZub ЄZub – Biotite granitic gneiss: Mesocratic (CI<35), greenish gray to gray, fine- to medium-grained rocks. Boulder fields and massive outcrops are well foliated granoblastic gneiss. Biotite is the dominant phyllosilicate, but locally sparse white mica highlights the foliation. Locally preserves relict plutonic textures and is crosscut by fine-grained aplitic dikes.

Metavolcanic Units

Cary Metamorphic Suite

ЄZslg ЄZslg – Sycamore Lake greenstone and meta-microdiorite: Mesocratic (CI>50), variably light green, gray-green, and dark black-green, fine- to medium-grained rocks containing chlorite, epidote, albite, white mica and minor biotite. Has a crystalloblastic matrix that locally contains relict porphyritic plagioclase and porphyroblastic actinolite in greenstone. Equigranular, finely phaneritic and sausseritized plagioclase and blocky actinolite define the microdiorite. Where foliated, forms white mica chlorite phyllite, phyllonite or schist. Forms enclaves in the Reedy Creek metagranodiorite.

ЄZtca ЄZtca – Turkey Creek amphibolite: Melanocratic (CI>65), dark gray-green to black-green, fine- to medium-grained, and moderately to well-foliated and locally lineated. Plagioclase, hornblende, biotite, chlorite, and epidote form a granoblastic to lepidioblastic matrix in amphibolite, biotite amphibolite, and hornblende gneiss. Relict phaneritic textures and cross-cutting relationships are used to identify outcrops of metagabbro, while relict plagioclase phenocrysts are preserved in some fine-grained amphibolite inferred to be metabasalt. Locally contains porphyroblastic hornblende. Units of the Umstead metaintrusive suite complexly intrude the amphibolite.

ЄZrs ЄZrs – Reedy Creek Lake schist: Melanocratic (CI=100), dark green to greenish-tan, medium-grained to porphyroblastic, moderately to well-foliated actinolite chlorite talc schist. Float exposures occur west of Reedy Creek Lake in Umstead State Park. Protolith may be pyroxenite or peridotite associated with the Turkey Creek amphibolite.

Crabtree Terrane

Metaintrusive Units

Crabtree Creek Pluton

ЄZglg ЄZglg – Glenwood leucogranitic gneiss: Leucocratic (CI<5), gray-white to pink-white, medium-grained, and well foliated and lineated, leucogranitic orthogneiss. Plagioclase, microcline, and white mica form a granoblastic mylonitic matrix that locally contains white mica and feldspar porphyroclasts and rod-shaped quartz aggregates. Exposed in the northwestern portion of the pluton adjacent to the Leesville fault. Prominent outcrops occur on Glenwood Avenue just east of Lynn Road.

ЄZccg ЄZccg – Crabtree Creek gneiss: Leucocratic (CI=5-10), greenish silver-gray, pink-gray, and tan-pink, medium- to coarse-grained, and well-foliated and lineated, porphyroclastic granitic orthogneiss. Plagioclase, microcline, white mica, biotite, and local tourmaline form a granoblastic and lepidioblastic mylonitic matrix surrounding up to 1 cm oblate and rod-shaped porphyroclastic quartz aggregates. Quartz shapes and white mica define a penetrative, subhorizontal L>S tectonite fabric. Irregularly shaped blocks and horizons of biotite amphibolite are inferred to be enclaves or transposed mafic dikes. Dominates the eastern portion of the pluton, and intrusive contacts are complexly transposed with the Richland Creek schist in its southern exposures (see Stop 4 in Stoddard and Blake, 1994).

Metasedimentary and Metavolcanic (?) Units

Crabtree Metamorphic Suite

ЄZrcs ЄZrcs – Richland Creek schist: Silver-gray, white-gray, or tan-white, fine- to medium-grained, compositionally layered, and well-foliated. Mixed metasedimentary pelitic and metavolcanic (?) felsic lithodemic layers of schist, phyllonite, and fine-grained gneiss. White mica, biotite, quartz, and feldspar define a lepidioblastic and granoblastic matrix for local garnet, staurolite, and tourmaline porphyroblasts, generally less than 1 cm in size. Contains white mica garnet graphite schist layers (CZwgs) that are less than 10 meters thick, and generally less than 1 meter thick. Graphite schist layers have variable lengths from 1 meter up to several km and their distribution is inferred to represent laterally discontinuous metasedimentary horizons (see Stop 4 in Blake et al., 2001).

ЄZspg ЄZspg – Southwest Prong gneiss: Leucocratic (CI<5-10), orange-gray and tan-white, dominantly very fine- to fine- and locally medium-grained, poorly to well-foliated depending on mica content. Lithodemic compositional layers vary in biotite content chiefly in a granoblastic microcline, plagioclase, quartz, and white mica matrix. Locally, horizons are magnetite-bearing. Mylonitic and ultramylonitic fabric element overprint obscures primary protolith textures and contact relationships, which may be volcanic or plutonic based upon its felsic bulk-rock composition (see Stop 3 in Blake et al., 2001).

ЄZwqs ЄZwqs – White mica quartzitic schist: Gold-gray and silver-gray, very fine- to fine-grained, compositionally layered, and well-foliated. Mixed metasedimentary pelitic and quartzitic, and metavolcanic (?) felsic layers of schist, phyllonite, and fine-grained gneiss. White mica, biotite, minor chlorite, quartz, and feldspar define a lepidioblastic and granoblastic matrix for local garnet, staurolite, and kyanite porphyroblasts, generally less than 1 cm in length. Contains three prominent white mica garnet graphite schist layers (ЄZwgs) that are greater than 10 meters thick, but continuously extend along the length of the unit and are locally known as the Raleigh Graphite.

ЄZbhg ЄZbhg – Biotite ± hornblende gneiss: Mesocratic (CI=30-50), white-gray to black-gray, very fine-grained to fine-grained, compositionally layered and well foliated. Variations in biotite, hornblende, plagioclase, and lesser white mica and microcline content produce the granoblastic or lepidioblastic lithodemic layering that is variable in thickness. Mylonitic and ultramylonitic fabric elements overprint primary protolith textures and contact relationships, which may have been volcanic or plutonic based upon its felsic bulk rock composition.

ЄZhcs ЄZhcs – Horse Creek schist: Silver-gray to tan-gray-white, medium- to coarse-grained, and well foliated, lineated, and compositionally layered pelitic metasedimentary rock. White mica, biotite, quartz, and feldspar define a lepidioblastic and granoblastic matrix for conspicuous porphyroblasts of garnet, kyanite, and minor staurolite. Variations in mica content versus felsic minerals define the schistose foliation that may be phyllonitic.

ЄZwgs ЄZwgs – White mica graphite schist: Silver-gray to black-gray, fine- to medium-grained, well foliated, and locally crenulated. White mica, graphite, biotite, and quartz form a schistose lepidoblastic matrix for conspicuous garnet porphyroblasts up to 5 mm in diameter that are commonly replaced by iron- and manganese-oxide minerals. Locally contains mm-scale kyanite and staurolite porphyroblasts. Three prominent layers in ЄZwqs are known as the Raleigh Graphite. (see Stop 3 in Stoddard and Blake, 1994, and Stop 4 in Blake et al., 2001). Three historic adits shown in ЄZwgs.

Raleigh Terrane

Metasedimentary and Metavolcanic (?) Units

ЄZflg ЄZflg – Falls Leucogneiss: Leucocratic (CI<5), orange-tan, white, pink-white or pink-gray, fine- to medium-grained, weakly to moderately foliated and penetratively lineated. Microcline, plagioclase, and quartz defines a granoblastic mylonitic matrix for aggregates of biotite and magnetite that form a mineral lineation in the mylonitic to ultramylonitic L>S tectonite fabric. Commonly forms rapids, massive pavement, waterfall outcrops, and dam sites along prominent drainages including Crabtree and Walnut Creeks. Boulders along Centennial Boulevard indicate that the leucogneiss crosscuts the Raleigh Gneiss as an A-type granitoid intrusion (see Stop 2 in Blake et al., 2001; Farrar, 1985a,b; Farrar and Owens, 2001).

ЄZrgn ЄZrgn – Raleigh Gneiss: Leucocratic to melanocratic (variable CI), white-tan-pink to gray-black to black, fine- to coarse-grained, compositionally layered, foliated, and locally lineated. Variations in biotite, hornblende, and granoblastic plagioclase, microcline, and quartz content and crystal size define the complex cm- to meter-scale, discontinuous compositional layering that displays a migmatitic aspect and protomylonitic or mylonitic fabric elements. Clinopyroxene, scapolite, calcite, apatite, titanite, garnet, white mica, and epidote occur locally. Gneissic layers display mutually concordant or discordant relationships and indicate a complex, multi-intrusive history involving magmas ranging from gabbroic to granitic. Moderately to weakly foliated biotite, microcline, plagioclase, and quartz granitic gneiss, pegmatitic granite, and fine-grained aplite commonly cross-cut mesocratic and melanocratic biotite gneiss, biotite hornblende gneiss, and amphibolite (see Stop 1 in Blake et al., 2001).

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EXPLANATION OF MAP SYMBOLS

CONTACTS

Lithologic contacts - Distribution and concentration of structural symbols indicates degree of reliability.

geologic contact
inferred geologic contact
concealed geologic contact
gradational geologic contact
ЄZwgs layers
fault - D indicates downthrown side, U indicates upthrown side ? indicates extent uncertain

FOLDS

inferred trace of F_3 axial surface of major- and minor-scale antiform
inferred trace of F_3 axial surface of major- and minor-scale synform
inferred trace of F_2 axial surface of major synformal antiform

CROSS SECTION

lithologic contact
gradational geologic contact
axial trace of Raleigh antiform (F_3 fold)
inferred axial trace of F_2 fold
ductile strike-slip fault. Letters showing relative direction of movement; T, toward observer; A, away from observer
ductile normal fault

PLANAR FEATURES

Observation sites are centered on the strike bar or are at the intersection point of multiple symbols. Planar feature symbols may be combined with linear features.

Strike and dip of inclined regional foliation (S_R)
Strike and dip of vertical regional foliation (S_R)
Strike and dip of inclined shear foliation (S_C)
Strike and dip of vertical shear foliation (S_C)
Strike and dip of F_2 fold hinge with S_2 axial surface
Strike and dip of F_3 fold hinge with S_3 axial surface
horizontal foliation

LINEAR FEATURES

Bearing and plunge of mineral lineation
Bearing and plunge of crenulation lineation
Bearing and plunge of L_2 mineral elongation lineation
Bearing and plunge of L_3 mineral stretch lineation

MINERAL RESOURCES AND OTHER FEATURES

1 abandoned graphite mine adit (Lead Mine Hill mine (Parker, 1979))
2 abandoned graphite mine adit (Old Lead Mines location (Parker, 1979))
3 abandoned graphite mine adit (Old Lead Mines location (Parker, 1979))
4 abandoned and reclaimed crushed stone and architecture stone quarry (Boone's quarry (Parker, 1979))
5 active crushed stone quarry (Crabtree quarry)
6 abandoned quarry (unnamed quarry in southwest Raleigh (Parker, 1979))
WR92-323 whole-rock geochemical sample location

UTM GRID AND 2004 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

1:24,000 SCALE
CONTOUR INTERVAL 10 FEET

Base topographic map is digital raster graphic image of the Raleigh West 7.5-minute quadrangle (1994), North Carolina State Plane NAD 83 meters coordinate system.

Field data plotted on mylar copy of Raleigh West quadrangle from 1968, revised 1987. Data digitized and projected on to 1994 quadrangle.

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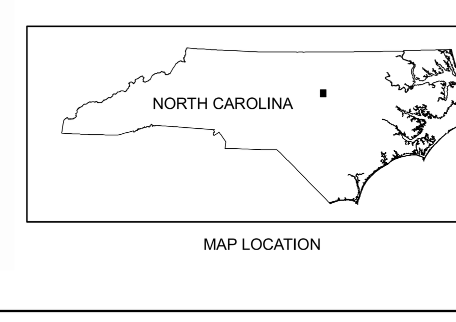
The views and conclusions contained in this document are those of the author and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Government.

Map reviews by Edward F. Stoddard, Matt Heller and Kevin Stewart.



MAP LOCATION

Scan with smartphone for link to GeoPDF of map. Third party App required.