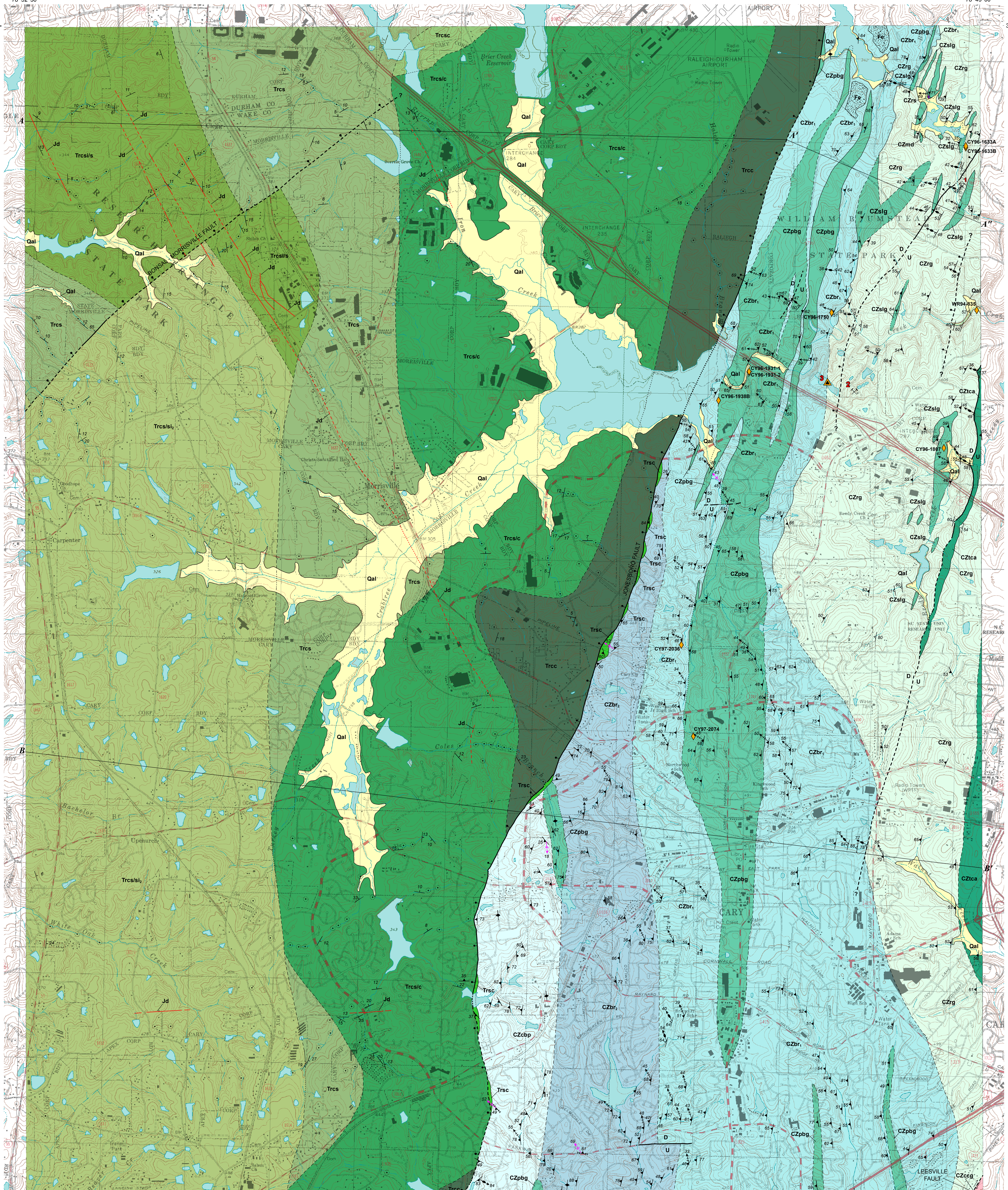
DEPARTMENT OF ENVIRONMENTAL QUALITY
KENNETH B. TAYLOR, STATE GEOLOGIST

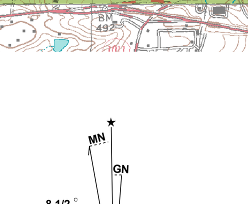
This geologic map was funded in part by the USGS National Cooperative Geologic Mapping Program

NORTH CAROLINA GEOLOGICAL SURVEY
OPEN FILE REPORT 2016-02



Base topographic map is digital raster graphic image of the Cary 7.5-minute quadrangle (1993), North Carolina State Plane NAD 83 meters coordinate system.

Field data plotted on mylar copy of Cary quadrangle from 1973, photorevised 1987. Data digitized and projected on to 1993 quadrangle.



UTM GRID AND 2003 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SCALE 1:24 000

1 0.5 0 1 Miles

1,000 500 0 1,000 2,000 3,000 4,000 5,000 6,000 7,000 Feet

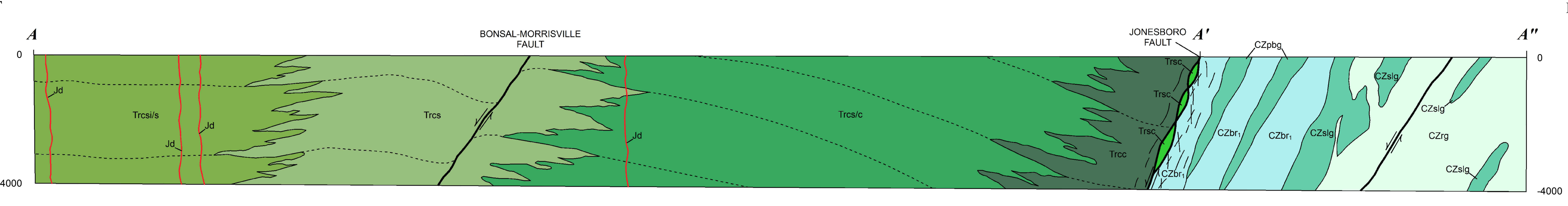
1 0.5 0 1 Kilometers

CONTOUR INTERVAL 10 FEET

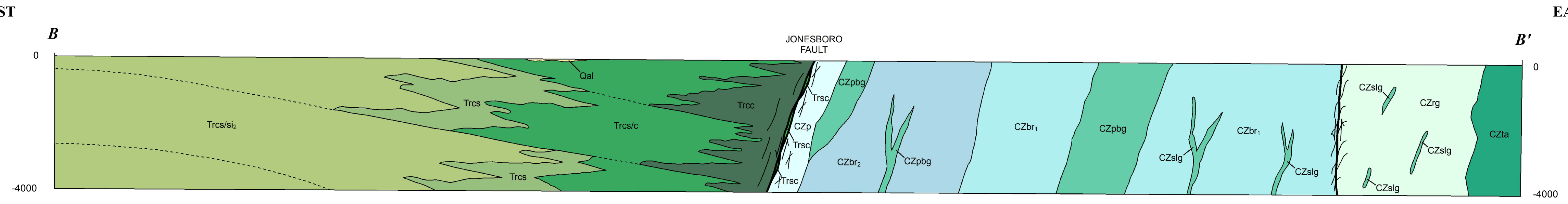
MAP LOCATION

This geologic map was funded in part by the USGS National Cooperative Geologic Mapping Program under StateMap.
Geology mapped by David E. Blake 1997 – 1998 (StateMap Award FY 1997).
Geology mapped by Timothy W. Clark 1998 – 2001.

Disclaimer:
This Open-File report is preliminary and has been reviewed for conformity with the North Carolina Geological Survey editorial standards. Further revisions or corrections to this Open File map may occur prior to its release as a NCGS Geologic Map Series.



cross sections: Depth in feet below ground surface - no vertical exaggeration
SCALE 1:24000



WHOLE ROCK GEOCHEMICAL ANALYTICAL RESULTS

				OXIDES IN PERCENT													SELECTED ELEMENTS IN PPM											
SAMPLE ID	Sample Interpretation	Unit Name	Map Unit	SiO2	TiO2	Al2O3	Fe2O3	MnO	MgO	CaO	Na2O	K2O	P2O5	Cr2O3	LOI	TOTAL	Ba	Ce	Co	Cu	Nd	Ni	Sc	Sr	Ta	Y	Zn	Zr
CY96-1633A	representative sample	Reedy Creek metagranodiorite	CZrg	75.70	0.23	12.50	1.35	0.02	0.24	0.98	4.08	3.90	0.03	<0.01	0.70	99.80	589	47.8	2.2	3.4	20.2	<1	3	88	2.7	23.8	23.2	126
CY96-1633B	representative sample	Sycamore Lake greenstone	CZslg	49.40	1.45	15.80	10.30	0.16	6.22	8.86	3.51	0.90	0.41	0.01	1.00	98.20	231	27.8	37	55.9	18.2	64	29	410	2	22.9	90.2	155
CY96-1750	representative sample	Big Lake-Raven Rock Schist 1	CZbr1	73.60	0.26	13.20	2.36	0.08	0.17	0.69	6.15	2.01	0.04	<0.01	0.35	99.10	770	63.1	1.4	2.7	37.7	<1	12	117	5.9	41.4	34.8	250
CY96-1807	felsic dike in CZslg	Sycamore Lake greenstone	CZslg	77.10	0.22	13.00	1.25	0.01	0.30	1.04	5.11	1.23	0.03	<0.01	0.75	100.10	660	31	2.3	<0.5	10.6	1	2	135	1.1	7.7	12.2	119
CY96-1931-1	representative sample	Sycamore Lake greenstone	CZslg	50.80	1.08	17.20	10.50	0.19	4.86	10.20	3.12	0.28	0.20	<0.01	1.30	99.80	109	18	32	49.8	13.1	14	36	443	1.7	16	63.3	92
CY96-1931-2	hornblende-rich sample	Sycamore Lake greenstone	CZslg	64.40	1.07	15.40	5.76	0.12	1.82	4.47	4.58	1.21	0.38	<0.01	0.45	99.80	757	48.3	5.8	1.7	31.2	<1	18	365	3.6	41	96	185
CY96-1938B	representative sample	Big Lake-Raven Rock Schist 1	CZbr1	73.80	0.30	13.20	2.26	0.03	0.48	2.00	4.55	1.49	0.06	<0.01	0.70	99.00	627	39.7	3.5	<0.5	19	<1	7	164	2.6	22.3	36.3	128
CY97-2036	representative sample	Big Lake-Raven Rock Schist 1	CZbr1	78.30	0.20	12.30	1.05	<0.01	0.13	0.66	5.17	1.32	0.02	<0.01	0.50	99.80	473	36	1.6	0.5	14.7	<1	5	118	2.1	16.1	11.1	121
CY97-2074	representative sample	Sycamore Lake greenstone	CZslg	46.40	1.03	19.70	9.34	0.15	6.05	9.53	3.83	0.14	0.23	<0.01	2.35	98.80	33	18.3	38	3.1	13.5	13	32	496	1.4	15.1	88.6	75
WR94-835	representative sample	Reedy Creek metagranodiorite	CZrg	72.30	0.32	14.00	1.91	0.02	0.67	1.62	4.10	3.29	0.08	NA	0.75	99.20	642	52	4.3	1.9	19	4	3.84	251	0.7	19	16.8	179

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 (12 trace elements reported in table). Whole-rock analyses using method codes XRF76Z + 75V, IMS95A, and FAI303, and individual element method code ICMS12B for Ta.

NA = Sample not analyzed for parameter
PPM = parts per million
LOI = loss on ignition

GEOLOGIC MAP OF THE CARY 7.5-MINUTE QUADRANGLE, WAKE AND DURHAM COUNTIES, NORTH CAROLINA

BY DAVID E. BLAKE AND TIMOTHY W. CLARK

Digital representation by Michael A. Medina

2016

Explanation

Pre-Mesozoic crystalline rocks in the eastern portion of the Cary Quadrangle represent the easternmost exposures of the Late Proterozoic to Cambrian Carolina terrane. A small portion of the Late Proterozoic to Cambrian Crabtree terrane is located in the extreme southeast corner of the quadrangle. Triassic sedimentary lithologic units of the Durham sub-basin of the Deep River Mesozoic rift basin underlie the western portion of the Cary Quadrangle.

Ultramafic to felsic units of the easternmost portion of the Carolina terrane (Cary sequence, Parker, 1979; Cary formation, Hibbard et al., 2002; Farrar, 1985a) have been metamorphosed to the chlorite zone of the upper greenschist facies during late Paleozoic contractional tectonothermal activity and early Mesozoic rifting. The small portion of the Crabtree terrane experienced amphibolite facies metamorphism. Only Triassic sedimentary rocks, Jurassic diabase dikes and sills, and silicified cataclasite are unmetamorphosed. Although Late Proterozoic to Cambrian volcanogenic rocks were subjected to low-grade metamorphism, locally undeformed, as well as foliated and cataclastically deformed rocks of the easternmost Carolina terrane preserve relict plutonic and volcanic igneous, as well as sedimentary textures, which allow for protolith identification. In other exposures, partitioned high strain produces mylonitic, ultramylonitic, and phyllonitic rocks of variable protolith affinity.

Metaigneous rocks in both 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 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. These rock units, which 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 Cary Quadrangle assisted the development of the current mapping results. Detailed descriptions of some lithodemic units are reported in Blake (1994), Stoddard and Blake (1994), and Blake et al. (2001).

Triassic sedimentary rocks of the Cary Quadrangle are part of the Chatham Group of the Newark Supergroup (Weems and Olsen, 1997) and occur in the east-central portion of the Durham sub-basin, a component basin of the Deep River Mesozoic rift basin. Detailed descriptions of Triassic sedimentary units are reported in Hoffman and Gallager (1989) and Clark et al. (2001). Due to the interfingering nature of these sediments and the lack of distinct marker beds, lithofacies mapping was utilized to group the rocks into mappable units. Hoffman and Gallagher (1989) identified distinct lithofacies in the Durham sub-basin. These lithofacies were grouped in three lithofacies associations, identified as Lithofacies Association I (LA I), Lithofacies Association II (LA II), and Lithofacies Association III (LA III). In general, LA I contains interbedded sandstone and siltstone and is interpreted as braided stream deposits. LA II also contains interbedded sandstone and siltstone, but is interpreted as a meandering fluvial system surrounded by vegetated floodplain. LA III contains poorly sorted sandstone, pebbly sandstone, and conglomerate. LA III is interpreted as alluvial fan complexes characterized by broad, shallow channels with high sediment concentrations, and locally, high-energy debris flows. LA I lithologies are not present in the map area.

Sedimentary Unit

Qal — **Qal - Quaternary 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 Unit

Jd — **Jd - diabase**: Dark green-black to gray-black, plagioclase and augite aphyric, and 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 not continuous.

Newark Supergroup, Chatham Group

Lithofacies Assoc. III

Trcc — **Trcc - conglomerate**: reddish-brown to dark brown, irregularly bedded, poorly sorted, cobble to boulder conglomerate. Muscovite is rare to absent in the very coarse-grained to gravelly matrix. An arbitrary cut-off of greater than 50 percent conglomerate distinguishes this unit from the Trcs/c facies. Clasts are chiefly miscellaneous felsic and intermediate metavolcanic rocks, quartz, epidote, bluish- gray quartz crystal tuff, muscovite schist, and rare meta-granitic material. Maximum clast diameters are in excess of 2 m along Haleys Branch east of the RDU airport.

Trcs/c — **Trcs/c - sandstone with interbedded conglomerate**: reddish-brown to dark brown, irregularly bedded, poorly sorted, coarse-grained to pebbly, muddy lithic sandstones with interbedded pebble to cobble conglomerate. Muscovite is rare to absent in the matrix. Well-defined conglomerate beds distinguish this unit from conglomerate basal lags of Trcs. An arbitrary cut-off of less than 50 percent conglomerate distinguishes this unit from the Trcc conglomerate facies. Conglomerate beds are channel-shaped and scour into the underlying sandstone beds. Unit grades eastward into Trcc.

Trcsc — **Trcsc - pebbly sandstone**: reddish-brown, pebbly, poorly sorted, coarse-grained, lithic, feldspathic sandstone; locally contains laterally discontinuous pebble and cobble trains and conglomeratic channel lags.

Trcs — **Trcs - interbedded sandstone and pebbly sandstone**: reddish-brown to dark brown, irregularly bedded to massive, poorly to moderately sorted, medium- to coarse-grained, muddy lithic arkoses, with occasional, matrix-supported granules and pebbles or as 1-5 cm thick basal layers. Muscovite is common to absent. Occasional bioturbation is usually surrounded by greenish-blue to gray reduction halos. Beds are tabular, 1-3 meters thick, with good lateral continuity. Unit grades eastward into Trcs/c.

Lithofacies Assoc. II

Trcsi/s — **Trcsi/s - siltstone with interbedded sandstone**: reddish-brown, extensively bioturbated, muscovite-bearing, siltstone interbedded with tan to brown, fine- to medium-grained, muscovite-bearing, arkosic sandstone, usually less than one meter thick. Siltstones can contain abundant, bedded, calcareous concretions (interpreted as caliche) and iron nodules. Bioturbation is usually surrounded by greenish-blue to gray reduction halos.

Trcs/si2 — **Trcs/si2 - sandstone with interbedded siltstone**: cyclical depositional sequences of whitish-yellow to grayish-pink to pale red, coarse- to very coarse-grained, trough cross-bedded lithic arkose that fines upward through yellow to reddish-brown, medium- to fine-grained sandstone, to reddish-brown, burrowed and rooted siltstone. Bioturbation is usually surrounded by greenish-blue to gray reduction halos. Coarse-grained portions contain abundant muscovite, and basal gravel lags consist of clasts of quartz, bluish-gray quartz crystal tuff, and mudstone rip-ups.

Fault Rocks

Trsc — **Trsc - silicified cataclasite**: tan, tan-brown, and white, silicified cataclasite that is commonly hematite stained limorite or displays hematite-filled fractures. Other fractures are in filled with idiomorphic to xenomorphic, massive milky quartz. Angular clasts of Triassic sedimentary units and the highly silicified and relict foliated crystalline rocks, especially the Coles Branch phyllite are common along the Jonesboro normal fault zone. Some clasts resemble chlorite-white mica phyllite or phyllonite of the Sycamore Lake greenstone.

Easternmost Carolina Terrane

Metaintrusive

CZrg — **CZrg – Reedy Creek metagranodiorite**: Leucocratic (CI less than 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, protomylonitic to 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.

CZslg — **CZslg – Sycamore Lake greenstone metadiorite and meta-microdiorite**: Mesocratic (CI greater than 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, sausseritized plagioclase, and blocky actinolite define the microdiorite. Where foliated, forms white mica chlorite phyllite, phyllonite, or schist, and display a dip-parallel lineation of chlorite-white-mica-quartz mineral aggregates or vein fibers. Forms enclaves in the Reedy Creek metagranodiorite.

Metavolcanic and Metasedimentary Units

Cary Metamorphic Suite

CZrs — **CZrs - Reedy Creek Lake schist**: Melanocratic (CI=100), dark green to greenish-tan, medium-grained and porphyroblastic, moderately to well foliated actinolite chlorite talc schist. Protolith may be pyroxenite or peridotite associated with the Sycamore Lake metadiorite and Turkey Creek amphibolite.

CZtca — **CZtca – Turkey Creek amphibolite**: Melanocratic (CI greater than 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 and metadiorite, while relict plagioclase phenocrysts are preserved in some fine-grained amphibolite inferred to be metabasalt. Locally contains porphyroblastic hornblende.

CZcbp — **CZcbp - Coles Branch phyllite**: Tan-white-orange to dark silvery gray, fine-grained, well-foliated and locally lineated rock. Mixed mafic and felsic lithodemic compositional layering alternate among white mica phyllite locally containing quartz and plagioclase phenocrysts, mesocratic white mica-chlorite-biotite phyllite, and locally very fine-grained greenstone and chlorite phyllite. Typically, high-strain mylonitic and/or phyllonitic fabric element overprint, especially adjacent to the Jonesboro normal fault, obscures primary protolith textures and contact relationships. These rocks may be volcanic or volcaniclastic based upon structural and lithodemic position with respect to the Big Lake-Raven Rock schist lithodeme. Identifiable, less silicified, clasts in Triassic silicified cataclasite typically are this phyllite.

CZpbg — **CZpbg – Pots Branch greenstone**: Melanocratic to mesocratic (CI greater than 50), variably light green, gray-green and dark black-green, fine- to medium-grained rocks containing chlorite, epidote, albite and actinolite. Has a crystalloblastic matrix that locally contains relict porphyritic plagioclase actinolite.

CZbr1 Fe — **CZbr1 - Big Lake-Raven Rock schist (upper)**: White-gray to white-tan to white, fine- to medium-grained, well foliated and locally lineated. Resistant outcrops are commonly white mica schist, although compositional layers containing biotite and/or chlorite are preserved. Locally, outcrops contain clasts including white to gray phyllite inferred to be metamorphosed lapilli tephra or fine-grained volcanic rocks, thereby preserving relict fragmental volcanic textures. Other outcrops contain a mixed assemblage of rounded clasts of mafic and felsic volcanic detritus that range up to 20 cm in length, reflecting a volcaniclastic protolith prior to metamorphism. Fe polygons indicate areas that contain float of iron-oxide rock. Local patches of ironstone float occur in hilltops surrounding Big Lake in Umstead State Park.

CZbr2 — **CZbr2 - Big Lake-Raven Rock schist (lower)**: White-gray to white-tan to white, fine- to medium-grained, foliated and locally lineated. Rock ledge-like outcrops of white mica quartzitic schist are common along tributaries to Sycamore, Crabtree, and Swift Creeks. Abundant resistant, relict phenocrysts of blue quartz, albitic plagioclase, and sanidine up to 3-5 mm in diameter are well preserved. Local domains of white mica phyllite or fine-grained schist up to several cm in length may be metamorphosed lapilli clasts or rock fragments. The mode, porphyritic texture, and inferred relict clasts suggest a felsic dacitic volcanic or volcaniclastic protolith for this lithodeme, which is mapped between Umstead and Raven Rock State Parks. Sycamore Lake greenstone and microdiorite forms compositional interlayers with the felsic schist. Local float cobbles and pebbles of iron stone occur in hilltops surrounding Big Lake in Umstead State Park.

Crabtree Terrane

Metaintrusive Unit

Crabtree Creek Pluton

CZccg — **CZccg – 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. This gneiss dominates the eastern portion of the Crabtree Creek pluton in the Raleigh West Quadrangle (see Blake, 1994).

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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
- diabase contact - solid where location known, dashed where inferred, dotted where concealed
- cross section
- fault - D indicates downthrown side, U indicates upthrown side, ? indicates extent uncertain
- brittle normal fault - solid where known, dashed where inferred, ? indicates extent uncertain

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.

- 42 Strike and dip of inclined bedding of Triassic sedimentary rocks
- 17 Strike and dip of inclined foliation (S_{rs})
- Strike and dip of vertical foliation (S_{rs})
- 26 Strike and dip of inclined shear foliation (S_{rc})
- 31 strike and dip of axial surface of F_4 folds associated with Mesozoic faulting

Linear Features

- 6 Bearing and plunge of mineral elongation lineation
- 9 Bearing and plunge of mineral stretch lineation
- 11 Bearing and plunge of crenulation lineation
- 42 Bearing and plunge of lineation

Cross Section

- lithologic contact
- fault line
- diabase
- ductile normal fault

Mineral Resources and Other Features

1 abandoned building stone quarry (Sycamore Creek quarry, Parker, 1979)

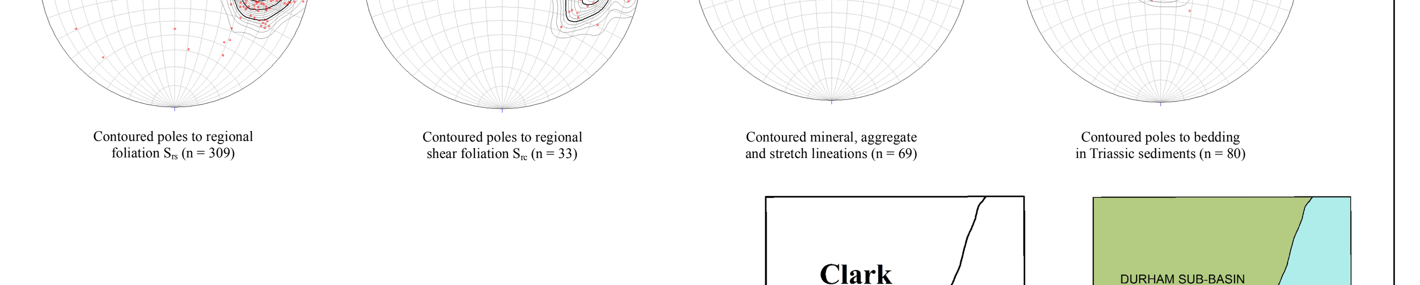
2 active crushed stone quarry

3 Three discordant fractions of euhedral, colorless to light pink zircon yield $^{207}Pb/^{206}Pb$ ages of 573, 574, and 579 Ma and an upper intercept age of 575 +- 12 Ma, interpreted as the time of crystallization (Goldberg, 1994).

CY97-2074 geochemical sample location

observation station location

Schmidt Equal Area Stereogram Data

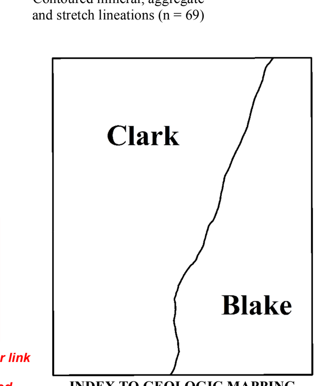


Contoured poles to regional foliation S_{rs} (n = 309)

Contoured poles to regional shear foliation S_{rc} (n = 33)

Contoured mineral, aggregate and stretch lineations (n = 69)

Contoured poles to bedding in Triassic sediments (n = 80)



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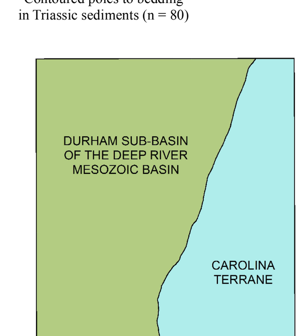

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