North Carolina Department of Environmental Quality
Energy Group
Jenny Kelvington, Executive Director
Kenneth B. Taylor, State Geologist

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North Carolina Geological Survey
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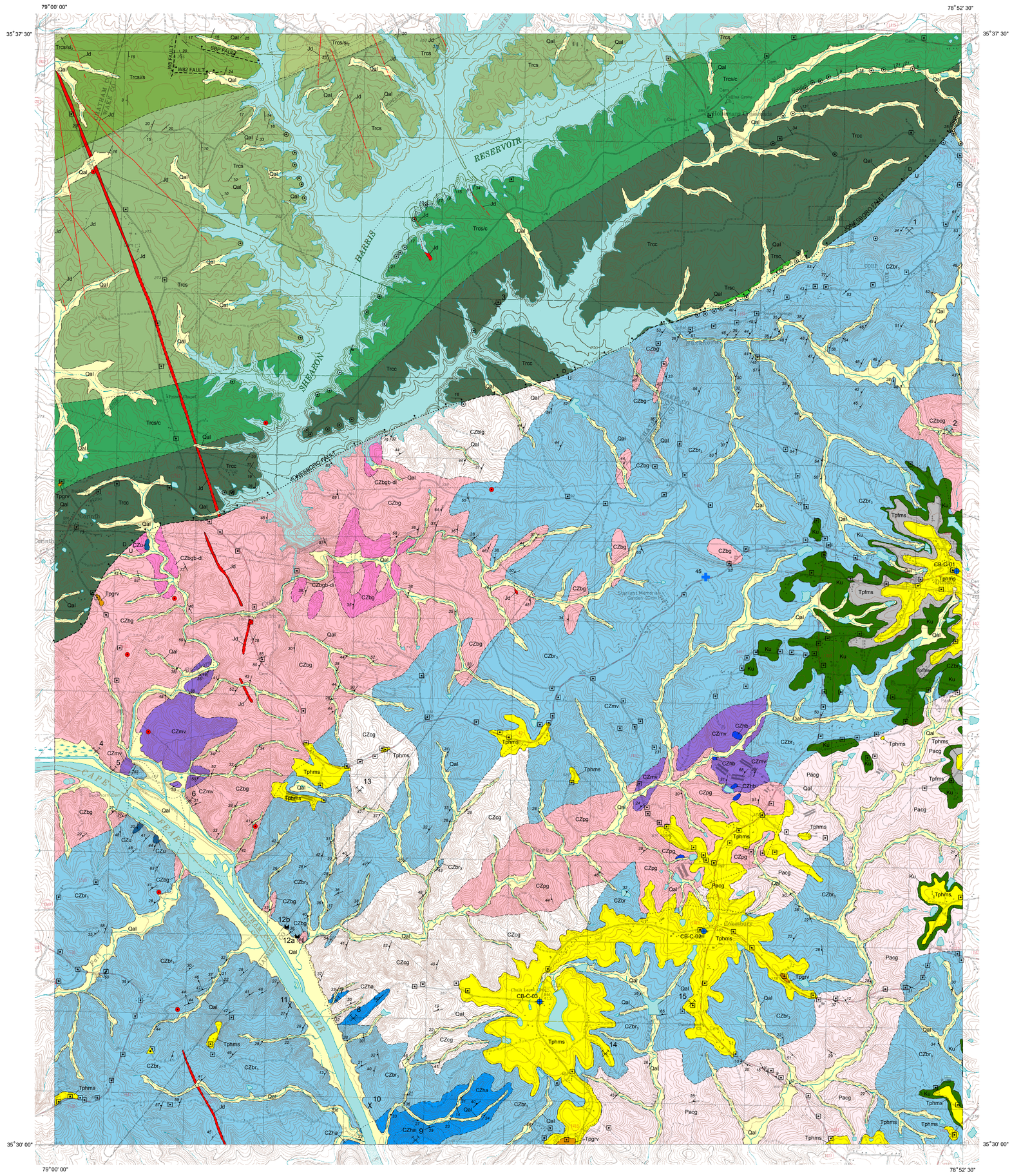

Description of Map Units

Pre-Mesozoic crystalline rocks in the Cokesbury Quadrangle represent some of the easternmost exposures of the Late Proterozoic to Cambrian Carolina terrane. Triassic sedimentary rocks of the Durham sub-basin of the Deep River Mesozoic rift basin underlie the northwestern portion of the Cokesbury Quadrangle. Unit descriptions common to Clark (manuscript map), Stoddard et al. (2016) and Blake et al. (1999) from the New Hill, Apex and Fuquay-Varina geologic maps respectively, are used and/or adapted for conformity with on-strike units.

Volcanogenic units of the easternmost portion of the Carolina terrane (the Cary sequence of Parker (1979); the Cary formation of Farrar (1985a) and Hibbard et al. (2002)) have been metamorphosed to the chlorite and biotite zones of the upper greenschist facies during late Paleozoic contractional tectonothermal activity and early Mesozoic extension. Mesozoic sedimentary, intrusive, and cataclastic rocks are unmetamorphosed. Despite the effects of deformation and metamorphism, Late Proterozoic to Cambrian volcanogenic rocks of the Carolina terrane in the Cokesbury Quadrangle typically preserve relict plutonic and volcanic igneous textures, or sedimentary textures, allowing for protolith identification. In some exposures, deformation and metamorphism has resulted in schistose and phyllitic rocks whose protoliths are difficult to discern.

Metaigneous rocks 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. Previous geologic maps and lithologic descriptions covering the Cokesbury Quadrangle (Parker (1979); Farrar (1985a, b) and Hicks (1982)) assisted in 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 Cokesbury 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.

Tertiary- to possibly Cretaceous-aged Coastal Plain sediments are present on topographic highs within the southeastern portions of the quadrangle.

Sedimentary Units

Quaternary

Qal – Alluvium: Tan to light gray, unconsolidated, poorly sorted and poorly 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. Structural measurements represent crystalline basement inliers, too small to map separately, that are surrounded by alluvium.

Cretaceous - Tertiary

Tpgrv – Gravel Patches: gravel layers as much as 3 m thick with rounded clasts of vein quartz and quartzite as much as 30 cm in diameter, typically overlain by 2 to 3 meters of dark red clayey sand and gravelly sand. Gravel layers are best developed within 5 km of the Cape Fear River; in general, the gravel layers decrease in thickness and size of clasts away from the river and probably grade laterally into finer-grained sediments of the Coastal Plain. The gravels are tentatively correlated with the Citronelle gravels that locally occur in the upper Coastal Plain, landward from the Orangeburg scarp. The gravels are mainly unconformable above deep saprolite derived from granite and felsic metavolcanic rocks, but in the southeastern part of the quadrangle were deposited (unconformably?) upon the Middendorf Formation.

Tphms – Heavy Mineral Bearing Sand: silty and clayey; reddish brown, tan, and gray; fine- to very- coarse grained; poor to moderately poor sorting; subangular to rounded quartz sand. Contains rare heavy minerals (dominantly a suite with staurolite, dravite and rutile); rare mica; rare rose quartz quartz. Massively bedded, rarely laminated. Near surface mottling usually obscures sedimentary structures. Basal contact is erosional. Unit is of probable Pliocene age.

Tpfms – Fine micaceous Sand: clay, and clayey silt; yellowish, orangish and reddish; unit is composed of two discrete lithofacies - the lower facies is characterized by medium to very coarse grained laminated quartz sand with internally graded laminae; moderately to poorly sorted; contains minor amounts of well-rounded and typically size-sorted (0.5-2cm) quartz pebbles, in thin beds and scattered within this lower section. Mica and whitish weathered feldspar are common constituents. Gradational contact with Upper portion, consisting of a very fine grained to medium-grained quartz sand with minor amounts of silt and clay; trace to about 10% mica; well to very well sorted; trace of very fine grained, rounded to well-rounded heavy minerals (dominantly dravite and rutile); massive to well-laminated; minor flaser bedding, with local well-developed wavy, lenticular and flaser bedding ; trace of bioturbation. Thickness ranges up to about 40-feet. The unit rests unconformably upon Ku.

Ku – Cretaceous Sediments, Undifferentiated: Unconsolidated to semi-consolidated, dark red to orange and yellowish-white sand and arkosic sand, locally with lenses of gravel. Plinthite and cross-bedding are present in some outcrops. The base of the unit is an unconformity. The upper part of the unit is weathered and reworked to loose, light gray to light brown sand and pebbly sand, as much as one meter thick, that may be washed downslope into stream valleys. This unit possibly includes strata of different ages, but it is poorly exposed and drill data are needed to define it adequately. This unit is tentatively assigned to the Cretaceous, but may include Coastal Plain sediments of Tertiary age.

Newark Supergroup, Chatham Group - Deep River Basin: Durham Sub-basin

Late Triassic

Lithofacies Assoc. III

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 locally.

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.

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 - 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/si$_2$ - 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 – Silicified cataclasite: tan, tan-brown and white, silicified cataclasite, commonly stained with hematite or limonite and/or displaying hematite-filled fractures. Other fractures are in filled with idiomorphic quartz crystals or massive milky quartz. Angular clasts of Triassic sedimentary units and the highly silicified and relict foliated crystalline rocks are common along the Jonesboro normal fault.

Intrusive Units

Jurassic

Jd – Diabase: Dark green-black to gray-black, aphyric to locally plagioclase phyric diabase, typically 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

Late Paleozoic

Pacg – Avents Creek granite: Leucocratic (CI=1-5), light gray to pinkish gray, fine to medium grained, composed chiefly of quartz, microcline perthite, and granophyres. Low color index, abundance of perthitic alkali feldspar, and plagioclase occuring almost entirely as a component of perthite is characteristic of this hypersolvus granite. Has accessory biotite, garnet, magnetite, and white mica. Generally massive outcrops, but may be locally foliated near wall-rock contacts. Forms a large pluton exposed along Avents Creek in the southeast portion of the quadrangle,and extends into the adjacent Fuqua-Varina Quadrangle to the east and northern Mamers Quadrangle to the south. The pluton age is uncertain, but it appears to be younger than metaintrusives of the Carolina terrane and may be middle to late Paleozoic(?).

Metaintrusive Units

Neoproterozoic - Cambrian

Buckhorn Dam Meta-intrusive Suite

CZpg - Parkers Creek metagranite: Dark gray (CI=15-20), generally fine grained, foliated to massive, garnet-biotite metagranite. Characterized in hand specimen by abundant biotite and conspicuous small garnet crystals, which give it a darker appearance than other nearby granites. The main minerals are plagioclase, perthitic microcline, quartz, biotite, garnet, and epidote, with small amounts of opaque minerals, muscovite, and sphene. The pluton crops out on both sides of Parkers Creek in its middle reaches.

CZcg - Chalk Level metagranite: Leucocratic (CI=5-8), light gray to pinkish white, fine- to medium-grained biotite metagranite. Generally has a distinct foliation with biotite as the main accessory mineral. The granite forms small plutons west of Chalk Level Church on the eastern side of the Cape Fear River valley and the lower valley of Parkers Creek.

CZbig - Meta-leucogranite of the Buckhorn Dam intrusive suite: Leucocratic (CI less than 5), light-colored, medium- to coarse-grained leucogranite with poorly developed foliation; composed mainly of plagioclase, quartz, and microcline, with minor amounts of chlorite, sericite, epidote, biotite, and opaque minerals.

CZbg - Meta-granitoid rocks of the Buckhorn Dam intrusive suite: Dark-colored (CI=15-30), medium- to fine-grained, metatonalite, metagranodiorite and metagranite with variably developed foliation; composed mainly of plagioclase, quartz, epidote, microcline, biotite, and opaque minerals, with minor amounts of sericite, sphene, chlorite, and garnet. The more felsic granitoid rocks are mineralogically and chemically similar to the felsic metavolcanic rocks described below, and are probably the intrusive equivalents. The unit includes a number of small granitoid bodies, probably originally dikes and plugs, intruding felsic metavolcanic rocks northeast of the main outcrops of Buckhorn Dam intrusive suite.

CZbcg – Buckhorn Creek metagranodiorite and metagranite: Mixed facies of mesocratic (CI greater than 25) dark gray to bluish gray, fine to medium grained, weakly to moderately foliated garnet-bearing biotite metagranodiorite and metagranite and leucocratic (CI less than 10) light pinkish tan to pinkish gray, fine to medium grained, weakly to moderately foliated and locally magnetite-bearing biotite metagranite. Exposed in the upper reaches of Buckhorn Creek, as well as in the Martin Marietta Aggregates Fuquay-Varina Quarry on the adjacent Fuquay-Varina quadrangle. May be northeastern equivalents of the metamorphosed granitoid rocks of the Buckhorn Dam intrusive suite (CZblg and CZbg) or the Parkers Creek metagranite (CZpg) exposed to the southeast.

CZbgb-di - Metamorphosed gabbro to diorite of the Buckhorn Dam intrusive suite: Dark green, coarse- to fine-grained, variably foliated metagabbro and metadiorite composed mainly of epidote, chlorite, hornblende (and/or actinolite), plagioclase, opaque minerals and minor quartz. The rocks appear to be gradational into granitoids of the Buckhorn Dam intrusive suite.

CZhb - Meta-hornblendite and hornblende metagabbro: Greenish-black, medium- to coarse-grained, massive rocks composed mostly of hornblende, with lesser amounts of plagioclase, epidote, biotite, quartz, and opaque minerals. The rocks occur in four isolated groups of outcrops and residual boulders, on both sides of Avents Creek north of Cokesbury. The largest body is about 250 meters across. The occurrences are interpreted to be intrusive plugs. The rocks are mineralogically similar to some rocks of the Buckhorn Dam intrusive suite but are spatially separated from the main part of the suite and may be unrelated.

CZu - Meta-ultramafic rocks: Dark green, coarse- to fine-grained, semi-schistose to massive rocks composed mainly of chlorite, actinolite, talc (?), opaque minerals, and epidote, locally with relict clinopyroxene. Rocks occur in three small areas; two small bodies occur on the western bank of the Cape Fear River and one is associated with (and probably gradational into) metagabbro just south of the Jonesboro fault near Corinth. The age is uncertain, but the rocks are possibly related to the Buckhorn Dam intrusive suite.

Metavolcanic and Metasedimentary Units

Neoproterozoic - Cambrian

Cary Metamorphic Suite

CZbr$_3$ – Big Lake-Raven Rock schist 3: Light tan to orange-brown, fine- to medium-grained, white mica schist, phyllite and gneiss. Locally preserves primary volcanic texture, either fragmental or porphyritic. Inferred to have a dacitic volcanic and/or volcaniclastic protolith. Locally includes intermediate to mafic composition rocks that have been metamorphosed to mica phyllite.

CZha - Hydrothermally altered rocks and mineralized zones: Quartz granofels, epidosite, muscovite-quartz schist, biotite schist, and iron ore. The rocks contain various combinations of quartz, muscovite, epidote, garnet, biotite, iron oxides, and manganese oxides. The rocks are fine- to medium-grained, and schistose to massive. This unit includes the Buckhorn-type iron ore deposits. Interpreted from boulders at the Buckhorn iron mine, the main seams of iron ore were as much as 2 meters thick. Protoliths of the altered rocks are probably felsic metavolcanic rocks and granite. The age of alteration and mineralization is uncertain, but the rocks are regionally metamorphosed and appear to be associated with the Avents Creek granitic intrusion or one of the older granites. Hicks (1982) interpreted the Buckhorn iron deposits as syngenetic volcano-sedimentary exhalatives.

CZmv - Interlayered mafic, intermediate, and felsic metavolcanic rocks: Mainly dark green to light gray, fine-grained metavolcanic rocks with well-developed schistosity; composed mainly of quartz, feldspar, epidote, chlorite, actinolite, biotite, and muscovite.

References:

Blake, D.E., 1994, Intrusive and deformational relationships of the Crabtree Creek pluton in west Raleigh, in Stoddard, E.F. and Blake, D.E., eds., Geology and Field Trip Guide, Western Flank of the Raleigh Metamorphic Belt, North Carolina, Raleigh, North Carolina Geological Survey, Carolina Geological Society Guidebook for 1994, p. 25-37.

Blake, D.E., Clark, T.W., and Heller, M.J., 2001, A temporal view of terranes and structures in the eastern North Carolina Piedmont, in Hoffman, C.W., ed. Field Trip Guidebook for the 50th Annual Meeting of the Southeastern Section, Geological Society of America, Raleigh, North Carolina, p. 149-180.

Blake, D.E., Butler, J.R., Clark, T.W., Carpenter, P.A. and Carpenter, R.H., (1999), Geologic map of the Fuqua-Varina 7.5-minute quadrangle, Wake and Harnett Counties, North Carolina: Open-file Report 1992-2 Revision 1 (2010), North Carolina Geological Survey, scale 1:24,000.

Clark, T.W., 1998, Fault-bend folding in the southern Durham Triassic basin, North Carolina , unpublished M.S. Thesis: Durham, North Carolina, Duke University, 84 p.

Clark, T.W., Gore, P.J., and Watson, M.E., 2001, Depositional and structural framework of the Deep River Triassic basin, North Carolina, in Hoffman, C.W., ed. Field Trip Guidebook for the 50th Annual Meeting of the Southeastern Section, Geological Society of America, Raleigh, North Carolina, p. 27-50.

Clark, T.W., manuscript map, Geologic map of the New Hill 7.5-minute quadrangle, Wake and Chatham Counties, North Carolina: Manuscript Map, North Carolina Geological Survey, scale 1:24,000.

Farrar, S.S., 1985a, Stratigraphy of the northeastern North Carolina Piedmont: Southeastern Geology, v. 25, no. 3, p. 159-183.

Farrar, S.S., 1985b, Tectonic evolution of the eastern Piedmont, North Carolina: Geological Society of America Bulletin, v. 96, p. 362-380.

Hibbard, J., Stoddard, E.F., Secor, D., Jr., and Dennis, A., 2002, The Carolina Zone: Overview of Neoproterozoic to early Paleozoic peri-Gondwanan terranes along the eastern flank of the southern Appalachians: Earth Science Reviews, v. 57, n. 3/4, p. 299-339.

Hicks, H.T., Jr., (1982), Geology and ore genesis of the Buckhorn District iron deposits, unpublished M.S. Thesis, Raleigh, North Carolina, North Carolina State University, 164p.

Hoffman, C.W. and Gallagher, P.E., 1989, Geology of the Southeast Durham and Southwest Durham 7.5-minute Quadrangles, North Carolina, Bulletin 92, North Carolina Geological Survey, 34 p.

Le Maitre, R.W., ed., 2002, Igneous Rocks: A Classification and Glossary of Terms: Recommendations of the International Union of Geological Sciences (IUGS) Subcommission on the Systematics of Igneous Rocks: Cambridge, Cambridge University Press, 252 p.

Nitze, H.B.C., 1893, Iron Ores of North Carolina: North Carolina Geological Survey Bulletin 1, 234 p.

Parker, J.M., 1979, Geology and mineral resources of Wake County: North Carolina Geological Survey Bulletin 86, 122 p., 1:100,000-scale map.

Stoddard, E.F. and Blake, D.E., eds., Geology and Field Trip Guide, Western Flank of the Raleigh metamorphic belt, North Carolina, Raleigh, North Carolina Geological Survey, Carolina Geological Society Guidebook for 1994, 110 p.

Stoddard, E.F., Clark, T.W., Gay, K.N. and Miller K., (2016), Geologic map of the Apex 7.5-minute quadrangle, Wake County, North Carolina: Open-file Report 2016-03, North Carolina Geological Survey, scale 1:24,000.

Weems, R.E. and Olsen, P.E., 1997, Synthesis and revision of groups within the Newark Supergroup, eastern North America, Geological Society of America Bulletin, v. 109, n. 2, p. 195-209.

MN
GN
6° 107 MILS
1° 12' 21 MILS
UTM GRID AND 1981 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
0.95 0.475 0 0.95 Kilometers
CONTOUR INTERVAL 10 FEET

MAP LOCATION

ADJOINING 7.5' QUADRANGLES

STRUCTURAL SYMBOLS

Observation sites are centered on the strike bar or are at the intersection point of multiple symbols.

planar features

17 strike and dip of inclined bedding in Triassic sedimentary rocks

23 strike and dip of inclined regional foliation (Srs)

28 strike and dip of inclined minor fault plane

linear features

44 Bearing and plunge of mineral lineation

Mineral Resources and Other Features

active crushed stone quarry
1 = Holly Springs Quarry
2 = Fuquay-Varina Quarry

abandoned quarry/pit/workings
Fe = iron
7 = Pegram Mine workings (Hicks, 1982 and Nitze, 1893)
8 = Pegram Mine workings (Hicks, 1982 and Nitze, 1893)
9 = Buckhorn Iron Mine (Hicks, 1982 and Nitze, 1893)
St = building stone
3 = unnamed building stone quarry or workings
4 = unnamed building stone quarry or workings
5 = unnamed building stone quarry or workings
6 = unnamed building stone quarry or workings
Gv = sand and gravel
13 = unnamed sand and gravel pit or workings
14 = unnamed sand and gravel pit or workings
15 = unnamed sand and gravel pit or workings

X 10 and 11 = abandoned iron prospects

12a and 12b = Buckhorn furnaces ruins (Hicks, 1982 and Nitze, 1893)

station location

diabase station location

massive quartz boulders

Symbols Related to Coastal Plain Mapping

data collection location - Coastal Plain mapping

CB-C-02 core location and number

45 hand auger location and number

CONTACTS

Lithologic contacts - Solid where location known, dashed where inferred, dotted where concealed.

FAULTS

D
U

Late brittle normal (?) faults suggested by the occurrence of vuggy quartz and breccia. D indicates downthrown side. Location of in situ vuggy quartz and breccia shown by orange triangles. Where in situ fault plane features were observed, the faults are near vertical or dip steeply to the north. Relative fault movement is thus inferred to be down to the north.

Base topographic map is digital raster graphic image of the Cokesbury 7.5-minute quadrangle (1974 - photorevised 1981), North Carolina State Plane NAD 83 meters projection.

This is an Open-File Map. It has been reviewed internally for conformity with North Carolina Geological Survey mapping standards and with the North American Stratigraphic Code. Further revisions or corrections to this Open File map may occur.

Research supported by the U.S. Geological Survey, National Cooperative Geologic Mapping Program. This map and explanatory information is submitted for publication with the understanding that the United States Government is authorized to reproduce and distribute reprints for governmental use. The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either express or implied, of the U.S. Government.

Crystalline rocks mapped in 1993 and 1994 by Butler, with partial STATEMAP support by FY 1994 funds.

Triassic sedimentary rocks were mapped in 1995 and 1996 by Clark. Data was compiled with the Triassic portions of the New Hill, Fuquay-Varina, and Apex quadrangles in Clark (1998).

Coastal Plain sedimentary units mapping conducted in 2000 and 2001 by Gay under STATEMAP Award #01HQAG0061, FY 2001.

NC Environmental Quality

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Geologic Map of the Cokesbury 7.5-minute Quadrangle, Harnett, Chatham, Wake and Lee Counties, North Carolina

Geology by
J. Robert Butler, Timothy W. Clark
and Norman K. Gay

Digital representation by Michael A. Medina and Philip J. Bradley

2016