North Carolina Department of Environmental Quality
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North Carolina Geological Survey
Open File Report 2025-02

DESCRIPTION AND SCHEMATIC DISTRIBUTION OF TERRANES AND MAP UNITS

INTRUSIVE ROCKS (Unmetamorphosed)

Mesozoic

Jd — Diabase

Steeply dipping to vertical dikes of dark green-black or gray to bluish-black or black, melanocratic, slightly to severely weathered, fine- to medium-crystalline diabase that may be olivine, magnetite, and ilmenite bearing. Weathers to tan-gray, spheroidally rounded, dense boulders and cobbles or punky cobbles and pebbles that can be traced along strike when outcrop is absent. Locally porphyritic with phenocrysts of plagioclase. Typically present as dikes up to 100 ft wide. Mapped partly on the basis of aeromagnetic signature.

MISSISSIPPIAN TO PERMIAN INTRUSIVE ROCKS

Late Paleozoic

PPacg — Avents Creek granite

Leucocratic (CI=1-5), light gray to pinkish gray, fine- to medium-crystalline, composed chiefly of quartz, microcline perthite, and granophyre. Low color index, abundance of perthitic alkali feldspar, and plagioclase occurring almost entirely as a component of perthite are characteristic of this hypersolvus granite. Has accessory biotite, garnet, magnetite, and white mica. Generally massive outcrops, but locally foliated near wall-rock contacts. Forms a large northeast-trending pluton that extends northward into the southwest corner of the Raleigh 100K sheet (Clark et al., 2004).

PPgl — Lillington Pluton

Medium- to coarse-crystalline biotite granite. Rb-Sr whole-rock date 297±5 Ma. (Kish, 1983)

Neoproterozoic-Early Paleozoic

EASTERNMOST CAROLINA TERRANE

A sample from CZbr1 in the Raleigh 100K sheet contains discordant zircon fractions that yield TIMS $^{207}Pb/^{206}Pb$ crystallization ages of ca. 579-573 Ma and an upper intercept age of 575 ± 12 Ma (Goldberg, 1994).

Cary Metamorphic Suite

CZbr1 — Big Lake-Raven Rock schist 1

Light tan to white, fine- to medium-crystalline white mica quartzitic schist containing abundant relict phenocrysts of blue quartz and plagioclase or local white to gray rock clasts (lapilli).

CZbr3 — Big Lake-Raven Rock schist 3

Light tan to orange-brown, fine- to medium-crystalline, 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 layers of Pots Branch greenstone.

CZpbg — Pots Branch greenstone

Melanocratic to mesocratic (CI greater than 50), variably light green, gray-green and dark black-green, fine- to medium-crystalline rocks containing chlorite, epidote, albite and actinolite, with or without quartz, biotite, titanite, white mica, and opaque minerals. Has a crystalloblastic matrix that locally contains relict phenocrysts of plagioclase. Where epidote is abundant, these rocks are hard greenstones, but where sheet silicates predominate, they are phyllites. Biotite commonly altered to vermiculite.

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-crystalline, 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 m thick. Protoliths of the altered rocks were 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.

CZmas — Mafic schist and phyllite and sericite phyllite

Green, chlorite-actinolite schist, chlorite schist and sericite phyllite. Schist grades into dark green intermediate to mafic crystal tuffs. Intercalated lithologies include epidosite, hematite-rich epidote-quartzite breccia and chlorite phyllite. Small pyrite crystals are commonly found along the fine-grained quartz laminae. Hematite also commonly present. Small lenses of quartzo-feldspathic gneiss are intercalated with the unit. (Modified from Hicks,1982)

NUTBUSH CREEK FAULT

CRABTREE TERRANE

Age data from units in the Raleigh 100K sheet yield the following: CZccg yields TIMS U-Pb zircon ages of ca. 566-554 Ma (Goldberg, 1994). Horton and Stern (1994) reported TIMS $^{207}Pb/^{206}Pb$ ages of ca. 542 Ma for CZccg. A sample of Zmca yields an LA-ICP-MS zircon age of 562 ± 14 Ma (Fishel et al., 2024). A sample of Zhcs in the Raleigh 100K sheet yields a unimodal population of monazite U-Pb concordia ages ca. 300 Ma; rutile ages are ca. 335 Ma and 263 Ma (lower intercept isochron ages; Burgess et al., 2024). Two additional samples of Zhcs produce an LA-ICP-MS zircon lower concordia intercept metamorphic age of 287.09 ± 1.39 Ma, and a muscovite 40Ar/39Ar cooling age of 251.45 ± 1.6 Ma, respectively (Blake et al., 2021).

Metavolcanic and Metasedimentary Units

CZrcs — Richland Creek schist

Silver-gray, white-gray, or tan-white, fine- to medium-crystalline, 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 that are less than 10 m thick and generally less than 1 m thick. Graphite schist layers have variable lengths from 1 m up to several km and their distribution is inferred to represent laterally discontinuous metasedimentary horizons.

CZsph-gpb — Sericite phyllite interpreted from geophysical methods and boring data

Area in subsurface interpreted as sericite phyllite using geophysical and boring data from Lawrence and Hoffman (1993). Located in Crabtree terrane (?) in between the Nutbush Creek and Neuse River faults. Covered by Coastal Plain sedimentary deposits.

UPPER LITTLE RIVER TERRANE

CZulrs — Upper Little River schist

Silvery-gray, fine- to medium- crystalline, garnet + white mica schist. Garnets porphyroblasts up to 4 mm.

NEUSE RIVER FAULT

SPRING HOPE TERRANE

Age data from units in the Raleigh and Henderson 100Ks yield the following: Goldberg (1994) obtained a concordant TIMS $^{207}Pb/^{206}Pb$ zircon age of 619 ± 1.3 Ma for the Mill Creek gneiss in the Raleigh 100K map, while two discordant zircon fractions from metamorphosed dacitic crystal tuff yielded zircon ages of ca. 590 and ca. 589 Ma. Horton and Stern (1994) obtained a TIMS $^{207}Pb/^{206}Pb$ zircon age ca. 544 for a metamorphosed dacitic tuff. Stoddard and Miller (2011) analyzed a metadacite tuff in CZmgs that yielded a nearly concordant Ca-TIMS U-Pb zircon age of 628 ± 1.7 Ma; crystal-lithic dacite tuff ("Bluestone") in CZfmv yielded discordant zircon ages and an upper intercept of 524.9 ± 8.6 Ma. CZmgs lithic arenite and lithic wacke bear Maximum Depositional Ages that range from ca. 647 to 629 Ma (Blake et al., 2024). Fishel et al. (2024) report new LA-ICP-MS U-Pb zircon analyses of two metagranitoids (SHt) that return 539 ± 12 Ma and 508 ± 13 Ma crystallization ages in the Raleigh 100K map.

Metavolcanic and Metasedimentary Units

CZmsd-gpb — Metamorphosed sediments interpreted by geophysical methods and boring data

Area in subsurface interpreted as sericite phyllite and metamudstone in the northeast portion of the unit and metamorphosed graywacke and mudstone in the southwest portion of the unit using geophysical and boring data from Lawrence and Hoffman (1993). Metamorphosed conglomerate, sandstone and siltstone are present at Stevens Mill west of Goldsboro. Covered by Coastal Plain sedimentary deposits.

CZfv-gp1 — Metamorphosed felsic volcanic rocks interpreted from geophysical methods and boring data 1

Area in subsurface interpreted as felsic volcanic rocks using geophysical data from Lawrence and Hoffman (1993). Covered by Coastal Plain sedimentary deposits.

CZss — Metasiltstone

This unit is best exposed in the Raleigh 100K map where it is composed of fine-grained, yellowish-gray to greenish-gray metasiltstone. Composed of quartz, plagioclase, muscovite,and chlorite. Accessory minerals include titanite, epidote, apatite, and magnetite (?). Lacks well-defined bedding planes. Where covered by Coastal Plain sedimentary deposits, the mapped distribution of this unit is based partly on geophysical data.

CZsmv — Mafic phyllites and greenstone

This unit is best exposed in the Raleigh 100K map where it is composed of interlayered mafic and felsic phyllite and greenstone. Greenstone makes up approximately 5-10% of the unit and occurs as concordant and discordant bodies reaching 1.5 m in thickness. In the Spring Hope Quadrangle (in the Raleigh 100K), quartz + epidote greenstone is a local marker horizon (Stetler, 1997). Where covered by Coastal Plain sedimentary deposits, the mapped distribution of this unit is based partly on geophysical data.

CZsa — Argillite

This unit is best exposed in the Raleigh 100K map where it is composed of very fine-crystalline, light gray to light olive gray laminated argillite. Chlorite +/-muscovite, and +/- graphite (?) layers generally less than 1 mm thick alternate with thicker quartz-rich layers in Middlesex, Stancils Chapel, Selma, and Flowers quadrangles (Carpenter et al.,1994; Carpenter et al,1996a; Carpenter et al.,1998). Includes muscovite phyllite, slate, and sparse granular quartz-epidote rock and metamorphosed dacite crystal tuff in the Bunn East Quadrangle (Clark et al., 2004). Locally phyllitic with thinly laminated to massive metamudstone in Zebulon Quadrangle (Carpenter et al.,1996b). Laminated chlorite phyllite, metaconglomerate, and metagraywackes (?) are locally interbedded with the argillites in the Spring Hope Quadrangle. Where covered by Coastal Plain sedimentary deposits, the mapped distribution of this unit is based partly on geophysical data.

CZsph — Sericite phyllite

This unit is best exposed in the Raleigh 100K map where it is composed of fine-crystalline, white to light-gray phyllite or schist; typically with strongly developed crenulation cleavage. Locally includes felsic metavolcanic rock and quartz-epidote rocks. Unit is interpreted to be product of alteration of the CZsfv unit in the Raleigh 100K. In the Lake Wheeler Quadrangle (Clark et al., 2004) in the Raleigh 100K, the unit is a grayish-green muscovite phyllite and phyllonite commonly with lesser amounts of chlorite and sparse garnet. Where covered by Coastal Plain sedimentary deposits, the mapped distribution of this unit is based partly on geophysical data.

HOLLISTER FAULT

ROANOKE RAPIDS TERRANE

Meta-igneous rocks in the Roanoke Rapids 100K sheet yield TIMS $^{207}Pb/^{206}Pb$ zircon crystallization ages as young as the late Neoproterozoic Era. Horton and Stern (1994) reported ages of ca. 668 Ma and ca. 608 Ma for two metatonalite samples and ca. 377 Ma for a biotite granodiorite. Coler and Samson (2000) obtained 672.3 ± 2.1 Ma and 615 ± 0.6 Ma crystallization ages on a metagranodiorite and metagranite, respectively. Owens and Hamilton (2018) described U-Pb TIMS zircon ages for meta-igneous rocks including ca. 673 Ma (felsic metavolcanic rock), 628.6 ± 3.6 Ma and 625 ± 0.6 Ma (metagranitoids), 613.6 ± 0.9 Ma (metatonalite), and 609.5 ± 0.8 Ma (metagabbro). Carter et al. (2024) report new SHRIMP data of 675 ± 5 Ma, 623 ± 5 to 611 ± 5 Ma, and 600 ± 5 Ma for metagranitoids, and dominant age ca.c 1014 Ma, ca. 676 Ma peak age mode, and younger grains to ca. 380 Ma, as compared to ca. 419 Ma peak age mode and zircon grains as young as ca. 320 Ma for two metasiltstone samples, respectively. LA-ICP-MS analyses of metaconglomerate by Pollock et al. (2010) yield an MDA of less than ca. 615 Ma and a single grain ca. 480 Ma.

CZmto-gpb — Metamorphosed tonalite interpreted from geophysical methods and boring data

Area in subsurface interpreted as metamorphosed tonalite using geophysical and boring data from Lawrence and Hoffman (1993). Covered by Coastal Plain sedimentary deposits.

CZpy — Phyllonite

Hollister fault zone phyllonite. Light gray, light tan, and pale green, very fine crystalline, very thinly foliated, locally crenulated muscovite +/- chlorite phyllonite and phyllite. Locally includes sheared metavolcanic rock.

CZfv-gp2 — Metamorphosed felsic volcanic rocks interpreted by geophysical methods 2

Area in subsurface interpreted as felsic volcanic rocks using geophysical data from Lawrence and Hoffman (1993). Covered by Coastal Plain sedimentary deposits.

CZmiv-gpb — Metamorphosed mafic and intermediate volcanic rocks interpreted by geophysical methods and boring data

Area in subsurface interpreted as mafic and intermediate volcanic rocks using geophysical and boring data from Lawrence and Hoffman (1993). Covered by Coastal Plain sedimentary deposits.

CZsed-gp — Metamorphosed sedimentary rocks interpreted by geophysical methods

Area in subsurface interpreted as undifferentiated slightly metamorphosed mudstone, siltstone and sandstone using geophysical data from Lawrence and Hoffman (1993). Covered by Coastal Plain sedimentary deposits.

CZiv-gp — Metamorphosed intermediate volcanic rocks interpreted by geophysical methods

Area in subsurface interpreted as intermediate volcanic rocks using geophysical data from Lawrence and Hoffman (1993). Covered by Coastal Plain sedimentary deposits.

CZmss-gp — Metamorphosed sandstone interpreted by geophysical methods

Area in subsurface interpreted as metamorphosed sandstone geophysical data from Lawrence and Hoffman (1993). Covered by Coastal Plain sedimentary deposits.

CZmv-gp — Metamorphosed mafic volcanic rocks interpreted by geophysical methods

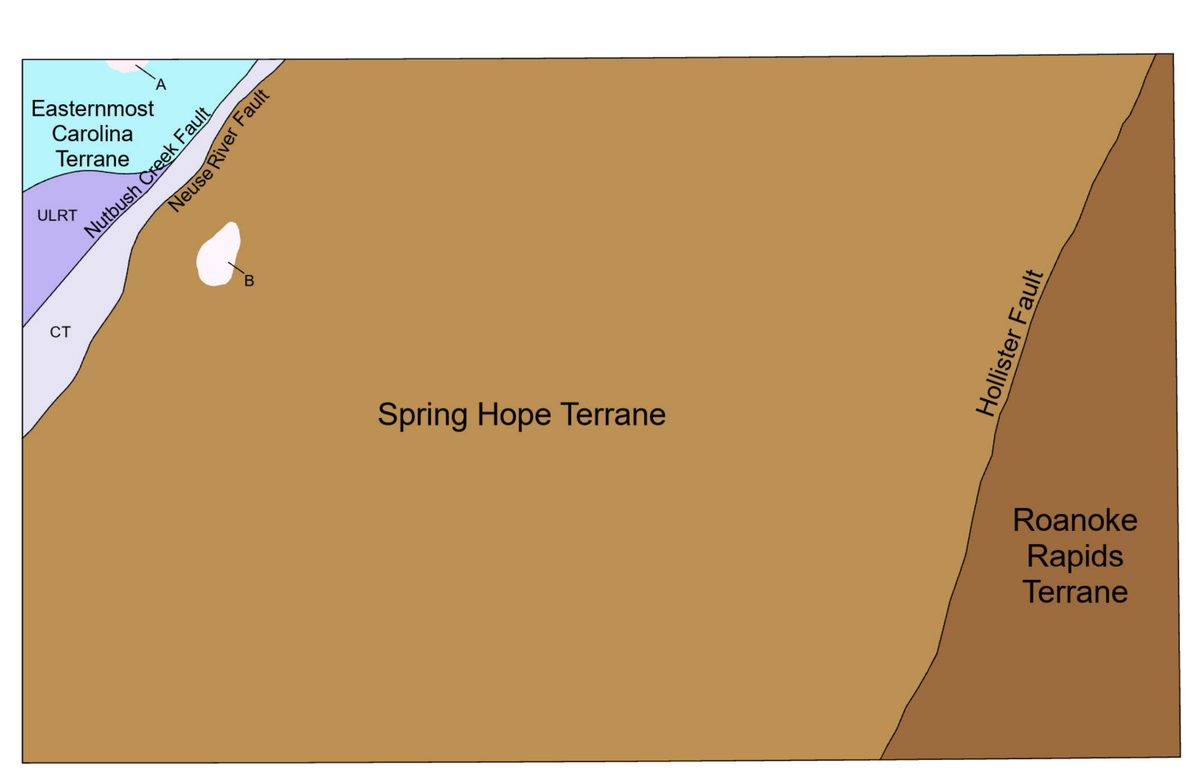
Area in subsurface interpreted as metamorphosed mafic volcanic rocks using geophysical data from Lawrence and Hoffman (1993). Covered by Coastal Plain sedimentary deposits.

CZms-gpb — Muscovite schist interpreted by geophysical methods and boring data

Area in subsurface interpreted as muscovite schist using geophysical and boring data from Lawrence and Hoffman (1993). Covered by Coastal Plain sedimentary deposits.

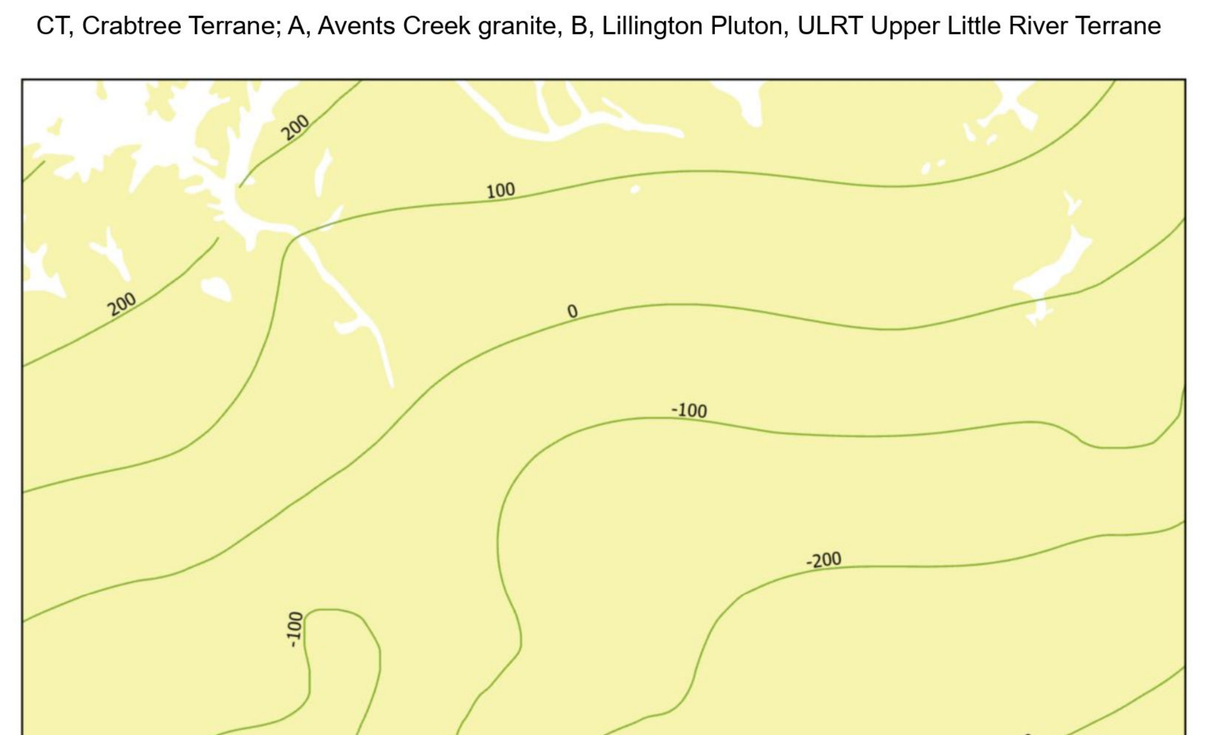
CZmdst-gpb — Slightly metamorphosed mudstone interpreted by geophysical methods and boring data

Area in subsurface interpreted as slightly metamorphosed mudstone using geophysical and boring data from Lawrence and Hoffman (1993). Covered by Coastal Plain sedimentary deposits.



INDEX TO TERRANES

CT, Crabtree Terrane; A, Avents Creek granite, B, Lillington Pluton, ULRT Upper Little River Terrane



General extent of Coastal Plain sedimentary deposits (from the 1985 NC State Geologic map) in the Fayetteville 100K sheet and elevation contours of top of basement.

Top of basement contours in feet above sea level.

Top of basement elevation contours from NC DEQ Division of Water Resources.

9.38 degrees west declination at center of sheet

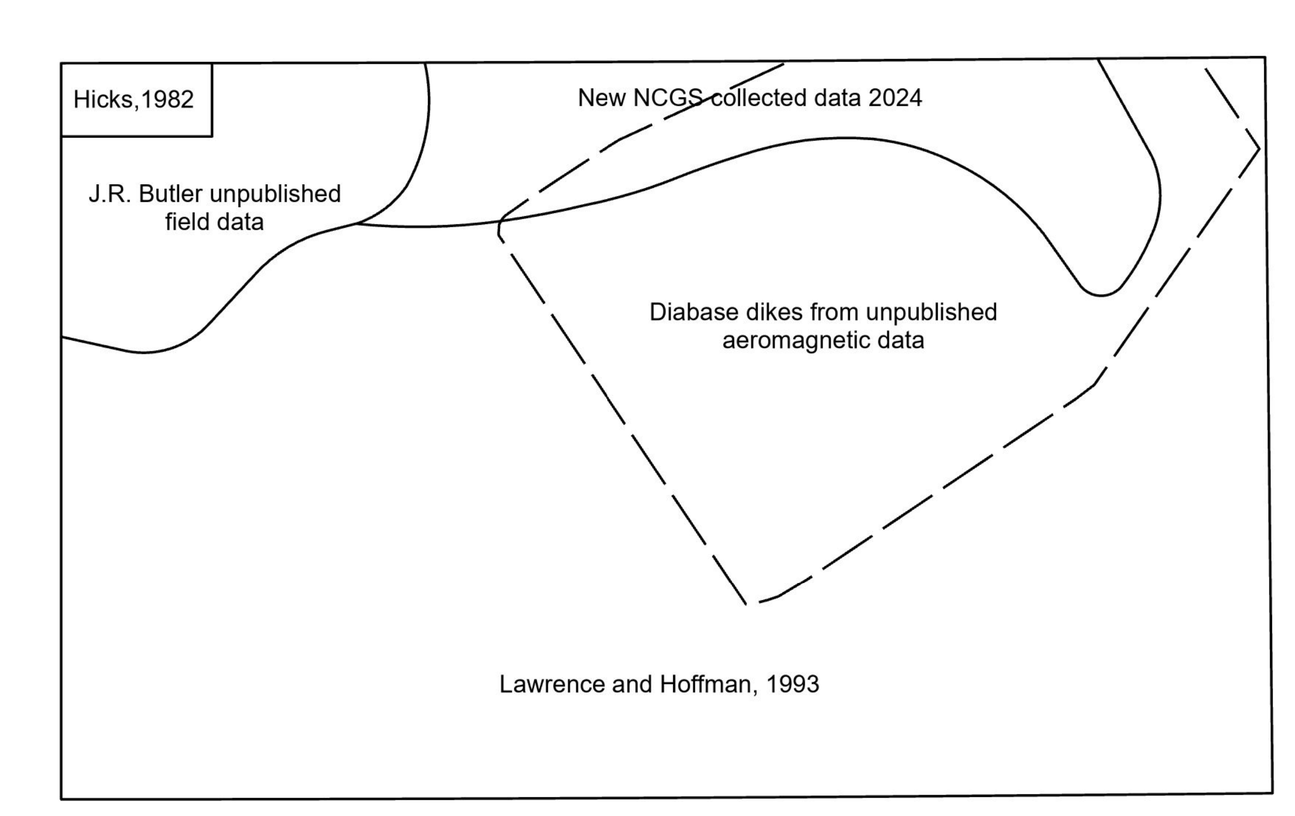
Lambert Conformal Conic projection
NAD 1983 State Plane North Carolina FIPS 3200 (Meters)

CONTOUR INTERVAL - 10 FEET

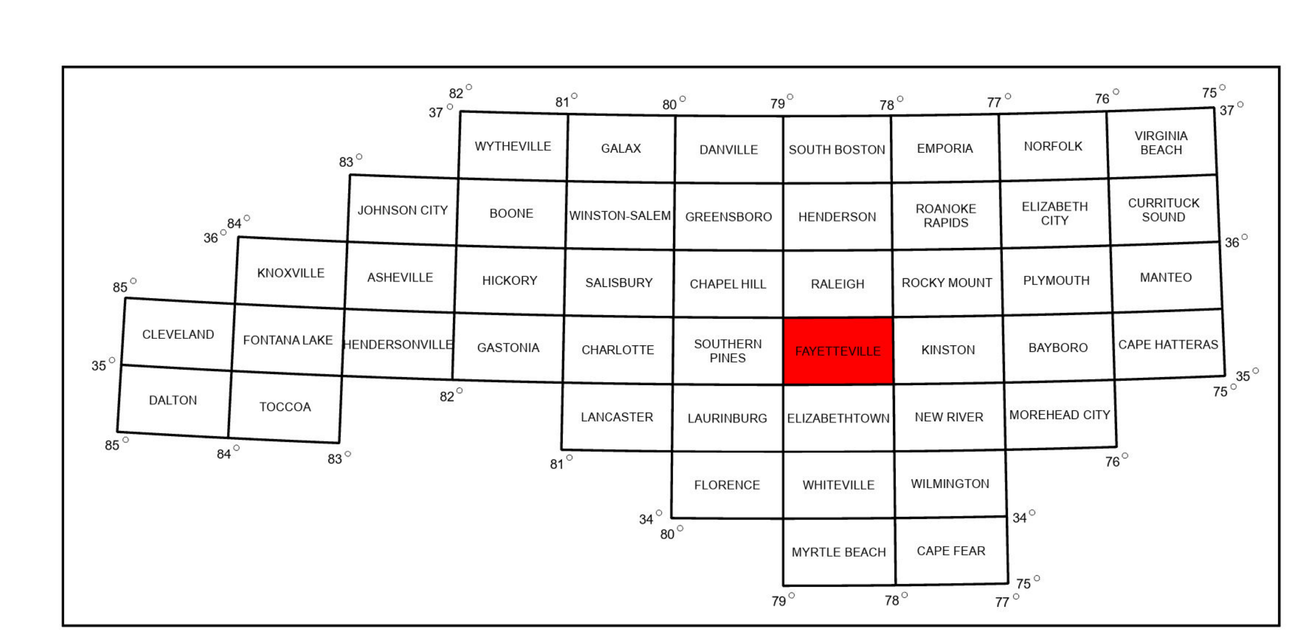
Base map contours provided courtesy of the USGS National Elevation Dataset.
Other data provided courtesy of NC One Map.

1 0.5 0 1 2 3 4 5 6 7 8 Miles

1 0.5 0 1 2 3 4 5 6 7 8 9 10 Kilometers



INDEX TO GEOLOGISTS



INDEX TO 1:100,000 MAPS

The goal of this compilation effort was to produce a new 1:100,000-scale digital geologic map of the study area using the USGS Geologic Mapping Schema (GeMS). When available, geologic data at scales more detailed than 1:100,000-scale were used (i.e. 1:24,000-scale data). In 2024, NCGS staff conducted targeted foot and vehicle traverses to validate contacts from the legacy sources and to collect new field data. Most of the Fayetteville 100K is overlain by Atlantic Coastal Plain sediments – see inset map. Bedrock is exposed in the northwest portion of the map area and along major rivers where incision has removed Coastal Plain cover. For areas in which the bedrock is covered by Coastal Plain sediments, data from Lawrence and Hoffman (1993) - Geology of basement rocks beneath the North Carolina Coastal Plain - was utilized. The sub-Coastal Plain geology of Lawrence and Hoffman (1993) was based on widely spaced drilled data and geophysical data that included aeromagnetic maps (Zietz and others, 1984) and Bouguer gravity maps (Black, 1986; Daniels and Leo, 1985). In 2024, the USGS Earth Mapping Resources Initiative (Earth MRI) began acquiring new high-resolution magnetic and radiometric data as part of the Piedmont Bridge South Magnetic and Radiometric Survey. This new survey covers the Fayetteville 100K. Edits to the sub-Coastal Plain geology in the map area will likely occur after review of the new data.

Research supported by the U.S. Geological Survey, National Cooperative Geologic Mapping Program under STATEMAP (Award 2023, G23AC00464).

New geologic data collected in May 2024 as part of this compilation work.

EXPLANATION OF MAP SYMBOLS

CONTACTS, FAULTS AND OTHER FEATURES

- Inferred contact, dotted where concealed, queried where questionable and/or covered by Coastal Plain sedimentary deposits
- Fault, queried where questionable and/or covered by Coastal Plain sedimentary deposits
- Concealed fault, ball and bar on downthrown block, queried where questionable and/or covered by Coastal Plain sedimentary deposits
- Fault inferred, strike-slip, right lateral; dotted where concealed, queried where questionable and/or covered by Coastal Plain sedimentary deposits
- Axis of Cape Fear Arch
- Inferred diabase dike, dotted where concealed
- Diabase dike, identified by geophysical methods

BASE MAP FEATURES

- Interstate
- US Route
- NC Route
- Secondary Route
- index contours (10 foot interval)
- minor contours
- river, creek or stream
- lake or pond
- swamp/wetlands

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Compiled bedrock geologic map of the Fayetteville 30' x 60' quadrangle, North Carolina

By: Philip J. Bradley, David E. Blake, Edward F. Stoddard and Qingxin Zhang

Cartographic representation by Qingxin Zhang, Garett J. Thompson, Michael A. Medina and Philip J. Bradley

2025

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