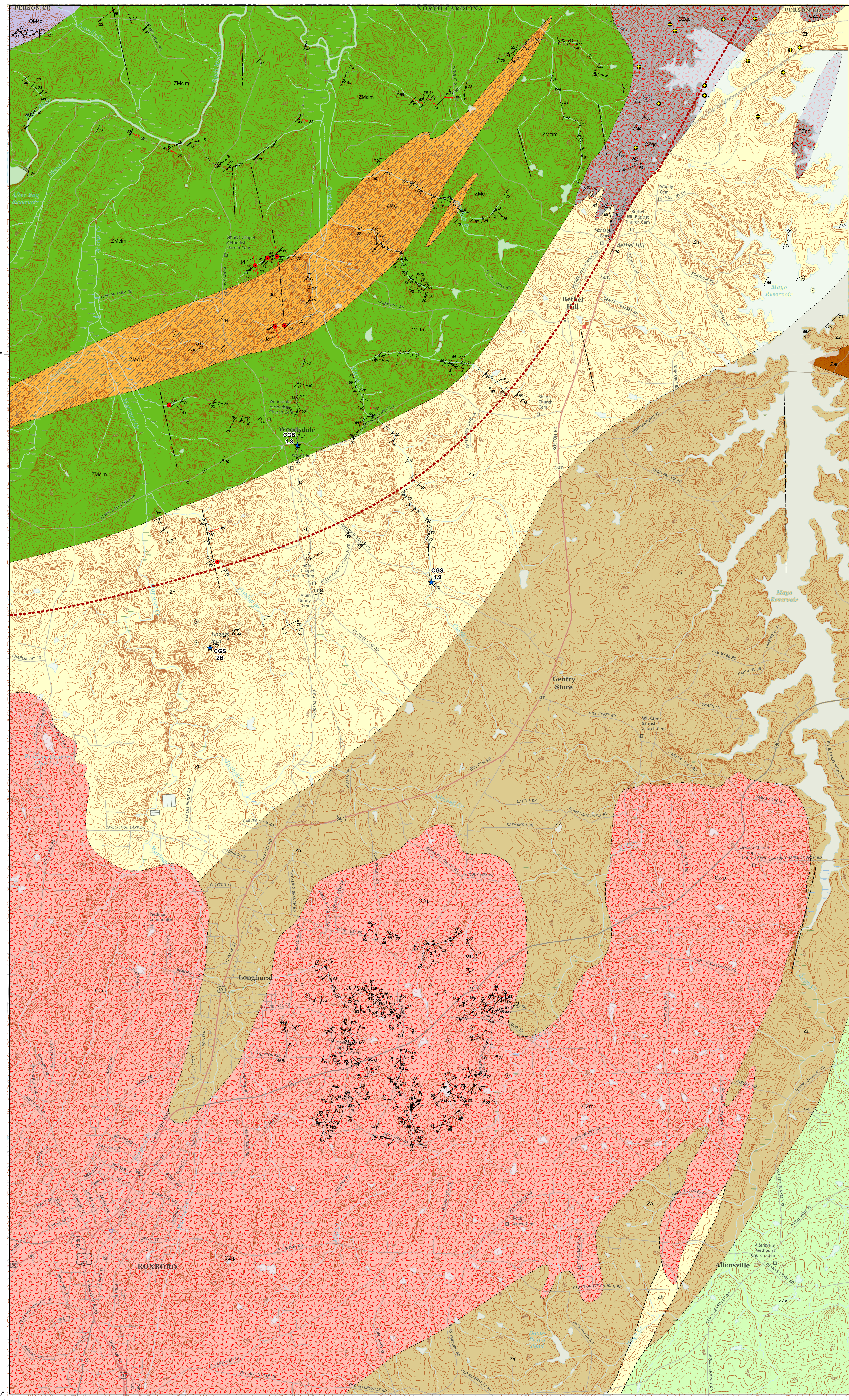
North Carolina Department of Environmental Quality
Policy and Innovation Group

Kenneth B. Taylor, State Geologist

North Carolina Geological Survey
Open File Report 2017-16



EXPLANATION OF MAP SYMBOLS

CONTACTS AND OTHER FEATURES

- inferred
- concealed
- fault inferred
- approximate southeastern limit of Hyco shear zone (gradational)
- diabase inferred
- linear geomorphic feature interpreted from hillshade LiDAR - origin unknown
- Strike and dip of inclined main phase foliation (SM)
- Strike and dip of inclined main phase foliation (multiple observations at one location)
- Vertical main phase foliation
- Horizontal main phase foliation
- Strike and dip of inclined main phase foliation and layering (SM + LYR)
- Strike and dip of inclined main phase foliation and layering (multiple observations at one location)
- Strike and dip of inclined late phase foliation (SL)
- Strike and dip of inclined late phase foliation (multiple observations at one location)
- Strike and dip of foliation (data from T. W. Clark)
- Strike and dip of foliation (data from T. W. Clark) (multiple observations at one location)
- Strike and dip of late pegmatite dike
- Vertical late pegmatite dike
- Strike and dip of cleavage
- Strike and dip of cleavage (multiple observations at one location)
- Strike and dip of joint
- Strike and dip of joint (multiple observations at one location)
- Bearing and plunge of mineral lineation (LM)
- Bearing and plunge of main phase fold axis (FM)
- Bearing and plunge of late phase fold axis (FL)
- Observation station location
- Diabase station location
- Crushed stone - abandoned
- Kyanite deposits
- Groundwater monitoring well locations with bedrock data Duke Energy Mayo Steam Electric Plant (SynTerra, 2015)
- CGS 1.8 — 2017 Carolina Geological Society field trip stop with number (Hibbard et al., 2017)
  - CGS 1.8 - Country Line Complex - tectonic slivers of Caswell mafic-ultramafic suite (Hyco arc)
  - CGS 1.9 - Hyco arc - Hyco Formation felsic lithic crystal tuff
  - CGS 2B - Hyco arc - Hager's Mountain kyanite occurrence

INTRODUCTION

This is a compiled geologic map of data from geologic investigations along the Hyco Shear Zone. Detailed discussions of the geologic interpretations are provided in Hibbard et al. (1998) and Hibbard et al. (2017). A small portion of the map area was mapped by Bowman (2010) and Bowman et al. (2013) as part of a graduate thesis. A one-mile radius centered on the GMH Electronics Superfund Site near Roxboro, NC was mapped by T.W. Clark under contract with the USGS (Chapman et al., 2013). Monitoring well boring location data from the Comprehensive Site Assessment Report for the Duke Energy Mayo Steam Electric Plant (SynTerra, 2015) is included on the map. Geologic contacts of Glover and Sinha (1973) were modified based on newly collected geologic data. The crushed stone (abandoned) and kyanite deposit locations from USGS Mineral Resources Data System (MRDS).

UNIT DESCRIPTIONS

Jd

Jd – Diabase: Black to greenish-black, fine- to medium-grained, diabase; consists primarily of plagioclase, augite and may contain olivine. Occurs as dikes up to 100 ft wide. Typically occurs as spheroidally weathered boulders with a grayish-brown weathering rind.

Milton Terrane – Milton-Chopawamsic Arc (ca. 475-450 Ma)

OMcc

OMcc - Cunningham complex: Heterogeneous mixture of medium to dark grey biotite gneiss and biotite schist ranging from massive, equigranular granitic gneiss to layers and lenses of biotite ± garnet ± sillimanite schist. The most common rock type is biotite gneiss that represents a hybrid between these two end-members, although distinct irregular-shaped areas of either end-member can be found. The granitic gneiss is locally K-feldspar megacrystic with crystals up to 50 mm long. Layering, at centimeter to meter scale, is defined by feldspar porphyroclast concentration as well as biotite content; it is generally subtle in most of the unit, but it is accentuated near the contact of the gneisses with the Country Line complex. Locally, meter-scale pods of amphibolite, dioritic gneiss, and calc-silicate gneiss are enveloped in a matrix of biotite gneiss. The granitic gneiss is compositionally similar to and appears to grade into the Carboniferous Kilgore orthogneiss. The biotite schist is similar to, and appears to grade into the Ordovician(?) Milton schist and paragneiss. Thus the complex appears to be a mixture of Ordovician and Mississippian rocks.

Carolina Terrane

The Country Line complex (ca. 614 – 323 Ma)

ZMclg

ZMclg – Unseparated biotite granite orthogneiss: Buff weathering, medium grey, weakly to strongly foliated, mainly medium grained biotite granite.

ZMclm

ZMclm – Neoproterozoic mafic gneiss and amphibolite interlayered with Mississippian pegmatites and orthogneiss: Greenschist to amphibolite facies mafic gneisses with interlayered granitoids and granitic pegmatites; subordinate biotite gneiss and minor metagyroxenite, semipelitic schist, and felsic schist (Shell, 1996). The mafic gneisses range from amphibolites to biotite-amphibole gneisses. Commonly, they are layered on a centimeter to meter scale, although in some places they are massive, with a medium- to coarse-grained gabbro-like texture. The mafic gneisses are extensively interlayered with granitic pegmatites, locally envelope brownish-grey, fine-grained granitoids, and are intruded by cross-cutting granitic pegmatites.

North of the Yanceyville granite gneiss (Yanceyville and Leasburg quadrangles), the complex is characterized by a very regularly layered (centimeter-scale), fine- to medium-grained grey biotite + blackish green amphibole gneiss with interlayered granitic gneiss (Shell, 1996). Locally, over the span of a few meters, the regularly layered gneiss grades into migmatite (sensu lato) with a network of foliated coarse granitoid containing meter scale pods of amphibolite with layering and foliation oblique to that in the granitoid.

Biotite gneiss is a minor component of the Country Line complex; typically it is a fine- to medium-grained equigranular, gray quartz-feldspar-biotite + garnet gneiss. Generally it forms massive and homogeneous lens-shaped bodies that are too small to be resolved at 1:24,000.

Zircon from a layered mafic gneiss sub-unit in the South Boston, VA area has yielded a discordant upper intercept age of 613.9 +/-9.3 Ma that is interpreted to reflect a protolith age for the mafic gneisses. Zircon and sphene from the same sample have yielded a concordant age of ca. 323 Ma (Wortman et al., 1998). Concordantly interlayered pegmatites increase in volume towards the Mississippian Yanceyville orthogneiss (Yanceyville and Leasburg quadrangles.), suggesting that the concordant pegmatites are also Mississippian. Thus, the complex is a mixture of Neoproterozoic and Mississippian rocks.

CZqd

CZqd – Quartz diorite plutons: Fine- to coarse-grained, heterogeneously foliated, biotite and/or amphibole bearing, quartz diorite.

Albemarle Arc (ca. 550-530 Ma)

CZrp

CZrp - Roxboro Pluton: Massive to locally very weakly foliated, leucocratic (CI less than 10), pinkish, medium- to coarse-grained, hypidiomorphic granular, metamorphosed granite. Mafic minerals present in rock are most commonly biotite intergrown with chlorite and/or hornblende intergrown with actinolite. Pluton map pattern truncates Aaron Formation units and Hyco Formation volcanics. Wortman et al. (2000) reported a U-Pb age of 546.5+3.0/-2.4 Ma for the Roxboro pluton (Olive Hill Quadrangle.). Boulder fields are a common geomorphic expression above the Roxboro pluton.

Aaron Formation (Youngest detrital zircons of ca. 578 and 588 Ma)

Zav

Zav – Virgilina volcanics: Mafic-felsic volcaniclastic rocks of the Virgilina member are typically homogenous and coarse- to fine-grained with variable amounts of quartz, feldspar, and lithic fragments (25% to greater than 75%). Description from Bowman (2010).

Zac

Zac – Aaron Conglomerate: The lower clastic rock member conglomerate marker unit is composed mainly of clasts of quartzite, vein quartz, and volcanic clasts that range from 2 cm -15 cm; locally, jasper and hematite/magnetite clasts occur. The conglomerate is typically poorly sorted, with slightly flattened rounded clasts that is clast supported in the upright limb and matrix supported in the overturned limb of the Virgilina syncline. Description from Bowman (2010). Youngest detrital zircons from Aaron Formation conglomerate range from ca. 578 to 588 Ma (Samson et al., 2001 and Pollock, 2010, respectively).

Za

Za – Aaron clastic sedimentary rocks: Mostly grey volcanic sandstone and siltstone. Volcanic sandstones are quartz- and feldspar-rich, ranging between 15% - 40% volcanic lithics and moderate amounts of opaques that are concentrated in layers parallel to bedding. Sandstones are medium-to coarse-grained with beds that range in thickness from 2 mm to 20 cm. Primary structures such as cross-bedding and graded bedding are commonly found throughout the unit. Outcrops of siltstones are massive to thinly bedded and bedded varieties consist of alternating light and dark greenish gray laminations that range from 1 to 5 mm thick. Description from Bowman (2010).

Hyco Arc (ca. 635-610 Ma)

Zh

Zh - Hyco Formation: Dominantly greenschist facies felsic volcanic and volcaniclastic rocks with subordinate intermediate and mafic components. The formation extends along the eastern margin of the Hyco shear zone. Primary features are well preserved in most of the Hyco Formation. The most common rock type is felsic crystal tuff containing abundant anhedral crystals of either quartz or plagioclase up to 3 mm in diameter. The tuffs are typically interlayered with felsic lapilli tuffs, quartz-muscovite phyllites, pebbly volcanic conglomerate, and intermediate to mafic crystal tuffs. The Hyco Formation records felsic to intermediate magmatism during a ca. 20 m.y. span starting at ca. 633 Ma (Wortman et al., 2000; Bradley and Miller, 2011).

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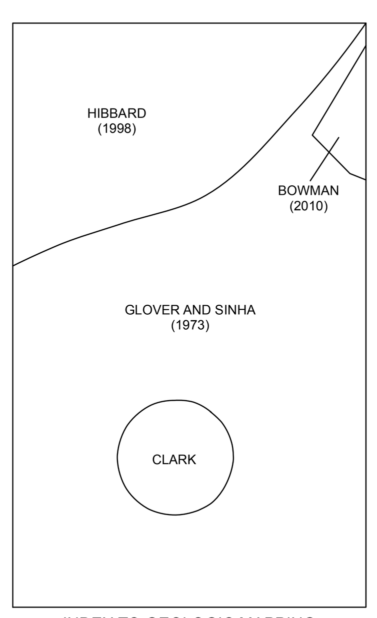
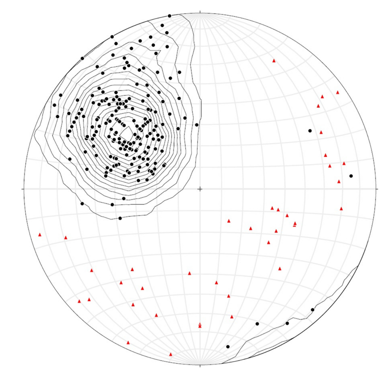


INDEX TO GEOLOGIC MAPPING

Equal-Area Schmidt Net Projections and Rose Diagram

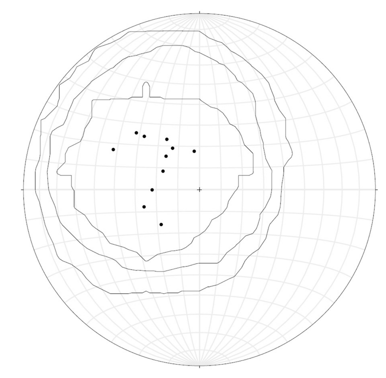
Plots and calculations created using Stereonet v. 8.6.0 based on Allmendinger et al. (2013) and Cardozo and Allmendinger (2013).



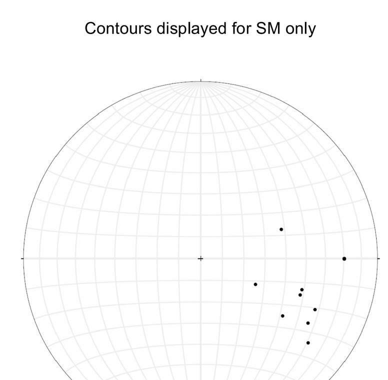
Equal Area Schmidt Net Projection of
Contoured Poles to Main Phase Foliation (SM) and
Layering (LYR) [black dots] and
Bearing and Plunge of Main Phase Lineations (LM) [red triangles]

Contour Interval = 2 sigma
Main Phase Foliation N=194
Late Phase lineations N=14

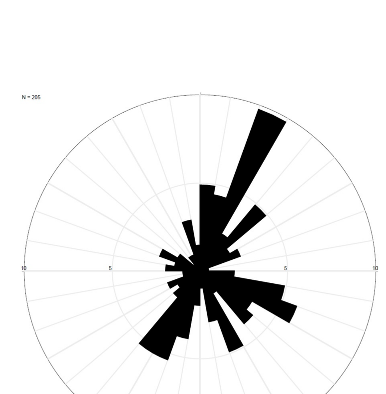
Contours displayed for SM only



Equal Area Schmidt Net Projection of
Contoured Poles to Late Phase Foliation (SL)
Contour Interval = 2 sigma
N =11



Equal Area Schmidt Net Projection of
Bearing and Plunge of late phase folds axes (FL)
N=9



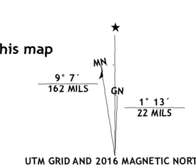
Unidirectional Rose Diagram of Joints
N = 205
Outer Circle = 10%
Mean vector = 013.8° ± 16.4°
Max value =15.12195% between 021° and 030°

Base map produced by the United States Geological Survey
Modified by the North Carolina Geological Survey for use with this map

North American Datum of 1983 (NAD83)
World Geodetic System of 1984 (WGS84). Projection and
1 000-meter grid: Universal Transverse Mercator, Zone 17S
10 000-foot ticks: North Carolina Coordinate System of 1983

Imagery....NAIP, June 2014
Roads.... U.S. Census Bureau, 2015 - 2016
Names....GNIS, 2016
Hydrography....National Hydrography Dataset, 2014
Contours....National Elevation Dataset, 2008
Boundaries....Multiple sources; see metadata file 1972 - 2016

Wetlands....FWS National Wetlands Inventory 1977 - 2014



UTM GRID AND 2016 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

FOR THE ROXBORO QUADRANGLE

U.S. National Grid
100,000-m Square ID
PA
Grid Zone Designation
17S

SCALE 1:24 000

KILOMETERS	1	0.5	0	1	2						
METERS	1000	500	0	1000	2000						
MILES	1	0.5	0	1							
FEET	1000	0	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000

CONTOUR INTERVAL 10 FEET
NORTH AMERICAN VERTICAL DATUM OF 1988

This map was produced to conform with the
National Geospatial Program US Topo Product Standard, 2011.
A metadata file associated with this product is draft version 0.6.19

QUADRANGLE LOCATION

ROAD CLASSIFICATION

- Expressway
- Secondary Hwy
- Ramp
- Local Connector
- Local Road
- 4WD
- Interstate Route
- US Route
- State Route

1	2	3
4	9	5
6	7	8

ADJOINING QUADRANGLES

1 Alton
2 Cluster Springs
3 Virgilina
4 Olive Hill
5 Triple Springs
6 Hurdle Mills
7 Timberlake
8 Moriah
9 Roxboro

CLUSTER SPRINGS, NC/VA
ROXBORO, NC

Environmental Quality

NC STATE UNIVERSITY

GEOLOGICAL SURVEY
N.C.
1823

Compiled Geologic Map of the Hyco Shear Zone and Adjacent Portions of the Cluster Springs and Roxboro 7.5-Minute Quadrangles, Person County, North Carolina

Geology by: James P. Hibbard
(includes data collected by Timothy W. Clark and Jeffrey D. Bowman and modified contacts of Lynn Glover, III and A.K. Sinha)

Digital Cartography by: Brandon T. Peach, Michael A. Medina, Randy Bechtel and Philip J. Bradley

2017

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.

ACKNOWLEDGEMENTS

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