North Carolina Department of Environment and Natural Resources
Divsion of Energy, Mineral, and Land Resources
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North Carolina Geological Survey
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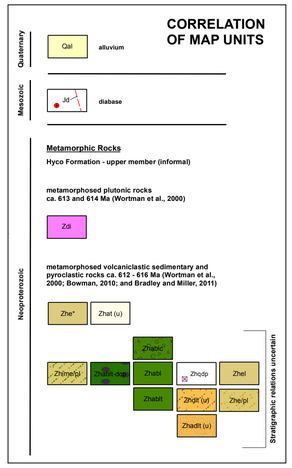
CORRELATION OF MAP UNITS



DESCRIPTION OF MAP UNITS

Pre-Mesozoic crystalline rocks in the Siler City Northeast Quadrangle are part of the redefined Hyco Arc (Hibbard et al., 2013) within the Neoproterozoic to Cambrian Carolina terrane (Hibbard et al., 2002; and Hibbard et al., 2006). In the region of the map area, the Carolina terrane can be separated into two lithotectonic units: 1) the Hyco Arc and 2) the Aaron Formation of the redefined Virgilina sequence (Hibbard et al., 2013). The Hyco Arc consists of the Hyco Formation which include ca. 612 to 633 Ma (Wortman et al., 2000; Bowman, 2010; Bradley and Miller, 2011) metamorphosed layered volcaniclastic rocks and plutonic rocks. Available age dates (Wortman et al., 2000; Bradley and Miller, 2011) indicate the Hyco Formation may be divided into lower (ca. 630 Ma) and upper (ca. 615 Ma) members (informal) with an apparent intervening hiatus of magmatism. In northeastern Chatham County, Hyco Formation units are intruded by the ca. 579 Ma (Tadlock and Loewy, 2006) East Farrington pluton and associated West Farrington pluton. The Aaron Formation (not present in the map area) consists of metamorphosed layered volcaniclastic rocks with youngest detrital zircons of ca. 578 and 588 Ma (Samson et al., 2001 and Pollock, 2007, respectively).

The Hyco Arc and Virgilina Formation lithologies were folded and subjected to low grade metamorphism during the ca. 578 to 554 Ma (Pollock, 2007) Virgilina deformation (Glover and Sinha, 1973; Harris and Glover, 1985; Harris and Glover, 1988; and Hibbard and Samson, 1995). In the map area, primary layering of Hyco Formation lithologies is interpreted to range from shallowly to steeply dipping due to open to isoclinal folds that are locally overturned to the southeast.

Map units of metavolcanic and metavolcaniclastic rocks include various lithologies that when grouped together are interpreted to indicate general environments of deposition. The dacitic lavas and tuffs unit (Zhdlt) is interpreted to represent dacitic domes and proximal pyroclastics. The andesitic to basaltic lavas (with tuffs or conglomerates) units (Zhabl, Zhablt and Zhablc) are interpreted to represent eruption of intermediate to mafic lava flows and associated pyroclastic and/or epiclastic deposits. The epiclastic/pyroclastic (Zhe/pl and Zhime/pl) units are interpreted to represent deposition from the erosion of dormant and active volcanic highlands. Some of the metavolcaniclastic units within the map area display lithologic relationships similar to dated units present in northern Orange and Durham Counties. Due to these similarities, the metavolcanic and metavolcaniclastic units have been tentatively separated into upper and lower portions of the Hyco Formation; geochronologic data in the map area are needed to confirm this interpretation.

The map area is located immediately north of the study area of Green et al. (1982), Abdelzahir (1978), and Green (1977). Their studies documented the presence of an overlapping series of metavolcanic and metavolcaniclastic lithologies sourced from distinct areas. The Siler City Northeast area is the source area for a portion of the lithologies identified in their studies. The southern portion of the quadrangle includes lithologies correlative to Green et al. (1982) units A and B.

Abundant evidence of brittle faulting at the outcrop scale as well as large-scale lineaments (as interpreted from hillshade LiDAR data) are present in the map area. The brittle faulting and lineaments are interpreted to be associated with Mesozoic extension. The Colon cross-structure (Reinemund, 1955), located immediately southeast of the Siler City Northeast Quadrangle, is a constriction zone in the Deep River Mesozoic basin and is characterized by crystalline rocks overprinted by complex brittle faulting. Dikes of Jurassic diabase intrude the crystalline rocks of the map area. Quaternary alluvium is present in most major drainages.

All pre-Mesozoic rocks in the map area have been metamorphosed to at least the chlorite zone of the greenschist metamorphic facies. Many of the rocks display a weak to strong metamorphic foliation. Although subjected to metamorphism, the rocks retain relict igneous, pyroclastic, and sedimentary textures and structures that allow for the identification of protolith rocks. As such, the prefix "meta" is not included in the nomenclature of the pre-Mesozoic rocks described in the quadrangle. Jurassic diabase dikes are unmetamorphosed.

The nomenclature of the International Union of Geological Sciences subcommission on igneous and volcanic rocks (IUGS) after Le Maitre (2002) is used in classification and naming of the units. The classification and naming of the rocks is based on relict igneous textures, modal mineral assemblages, or normalized mineral assemblages when whole-rock geochemical data are available. Pyroclastic rock terminology follows that of Fisher and Schminke (1984).

Sedimentary Units

Qal – Alluvium: Unconsolidated poorly sorted and stratified deposits of angular to subrounded clay, silt, sand and gravel- to cobble-sized clasts, in stream drainages. May include point bars, terraces and natural levees along larger stream floodplains. Structural measurements depicted on the map within Qal represent outcrops of crystalline rock inliers surrounded by alluvium.

Intrusive and Metaintrusive Units

Jd – Diabase: Black to greenish-black, fine- to medium-grained; dense, consists primarily of plagioclase, augite and locally olivine. Occurs as dikes up to 100 ft wide. Diabase typically occurs as spheriodally weathered boulders with a grayish-brown weathering rind. Red station location indicates outcrop or boulders of diabase.

Zhqdp - Quartz dacite porphyry: Micro-granitic to porphyritic with aphanitic groundmass and sub- to euhedral phenocrysts (2-6 mm) of white to salmon plagioclase and gray to dark gray (beta-) quartz; phenocrysts typically constitute 20 to 25% of the rock. May locally have fine-grained intrusive texture. Interpreted as either lava flows or shallow intrusives possibly associated with domes. Present as boulders in the northeast of quadrangle and as a less than 6 inch wide dike at one station. Similar to quartz dacite porphyry unit within the Bynum Quadrangle (Bradley et al., 2013).

Zdi – Diorite: Mesocratic (CI~50), greenish-gray to grayish-green, fine- to medium-grained, hypidiomorphic granular diorite. Major minerals include plagioclase and amphibole. Plagioclase crystals are typically sericitized and saussuritized. Amphiboles are typically altered to chlorite and actinolite masses.

Metavolcanic and Metavolcaniclastic Units
Hyco Formation - Upper Portion

Zhat (u) – Altered tuffs: Very light gray to light greenish gray (whitish in areas) with red and yellow mottling, altered volcaniclastic rocks. Alteration consists of silicified, sericitized and pyrophyllitized rock. Sericite phyllite, pods of pyrophyllite, and quartz + phyrophyllite rock all with less than 1 mm to 2 mm diameter weathered sulfides are common. Relict lithic clasts and kaolinitized feldspar crystal shards are visible in some exposures. Relict structures are obliterated in heavily altered rocks. Map area contains boulders (up to several feet in diameter) and outcrop of massive milky quartz and quartz + sericite rock.

Zhe* - Epiclastic rocks of the Southern Chatham County area: Grayish-green to green, locally with distinctive reddish-gray or maroon to lavender coloration, siltstones, sandstones, conglomeratic sandstone, and conglomeratic siltstone (graywacke). Siltstones are locally phyllitic. Siltstones typically display bedding ranging from mm-scale up to 10 cm, bedding layers traceable for several feet locally, may exhibit soft sediment deformation. Locally tuffaceous with a relict vitric texture. Locally contain interbedded intermediate to mafic lavas. Conglomerates and conglomeratic sandstones typically contain rounded to angular clasts. Deposition interpreted as distal from volcanic center. May be correlative to Green et al. (1982) unit B – Felsic Graywacke Unit.

Zhel - Epiclastic rocks and lavas: Conglomerate, conglomeratic sandstone, sandstone, siltstone and mudstone. Siltstones and mudstones typically display bedding ranging from mm-scale up to 10 cm, bedding layers traceable for several feet locally, may exhibit soft sediment deformation. Locally tuffaceous with a relict vitric texture. Locally contain interbedded dacitic to basaltic lavas. Conglomerates and conglomeratic sandstones typically contain subrounded to angular clasts of dacite in a clastic matrix. Deposition interpreted as distal from volcanic center, in deep water(?), and via turbidite flows.

Zhime/pl - Mixed intermediate to mafic epiclastic-pyroclastic rocks with interlayered intermediate to mafic lavas: Grayish-green to green, locally with distinctive reddish-gray or maroon to lavender coloration; conglomerate, conglomeratic sandstone, sandstone, siltstone and mudstone. Lithologies are locally bedded; locally tuffaceous with a cryptocrystalline-like groundmass. Siltstones are locally phyllitic. Locally contain interbedded intermediate to mafic lavas identical to Zhablt, Zhabl, and Zhablc units. Contains lesser amounts of fine- to coarse tuff and lapilli tuff with a cryptocrystalline-like groundmass. Pyroclastics, lavas, and epiclastics are mainly intermediate to mafic in composition. Minor dacitic lavas and tuffs present. Silicified and/or sericitized altered rock similar to Zhat unit are locally present. Conglomerates and conglomeratic sandstones typically contain subrounded to angular clasts of andesite and basalt in a clastic matrix. Generally interpreted to have been deposited proximal to active intermediate to mafic composition volcanic centers and/or record the erosion of proximal intermediate to mafic composition volcanic centers after cessation of active volcanism. May be related to Green et al. (1982) unit C – Intermediate to Mafic Volcanics and Graywacke.

Zhe/pl - Mixed epiclastic-pyroclastic rocks with interlayered dacitic lavas: Grayish-green to greenish-gray, locally with distinctive reddish-gray or maroon to lavender coloration; conglomerate, conglomeratic sandstone, sandstone, siltstone and mudstone. Lithologies are locally bedded; locally tuffaceous with a cryptocrystalline-like groundmass. Siltstones are locally phyllitic. Locally contain interbedded dacitic lavas identical to Zhdlt unit. Contains lesser amounts of fine- to coarse tuff and lapilli tuff with a cryptocrystalline-like groundmass. Pyroclastics, lavas, and epiclastics are mainly felsic in composition. Minor andesitic to basaltic lavas and tuffs present. Silicified and/or sericitized altered rock similar to Zhat unit are locally present. Conglomerates and conglomeratic sandstones typically contain subrounded to angular clasts of dacite in a clastic matrix. Portions of the Zhe/pl unit are interpreted to have been deposited proximal to active volcanic centers represented by the Zhdlt unit but are also interpreted to record the erosion of proximal volcanic centers after cessation of active volcanism. May be correlative to Green et al. (1982) unit A – Lower Felsic Volcanics.

Zhdlt (u) – Dacitic lavas and tuffs of the upper portion of the Hyco Formation: Greenish-gray to dark gray, siliceous, aphanitic dacite, porphyritic dacite with plagioclase phenocrysts, and flow banded dacite. Dacite with hyaloclastic textures is common. Welded and non-welded tuffs associated with the lavas include: greenish-gray to grayish-green, fine tuff, coarse plagioclase crystal tuff and lapilli tuff. Locally, interlayers of immature conglomerate and conglomeratic sandstone with abundant dacite clasts are present. The dacites are interpreted to have been coherent extrusives or very shallow intrusions associated with dome formation. The tuffs are interpreted as episodic pyroclastic flow deposits, air fall tuffs or reworked tuffs generated during formation of dacite domes. The unit occurs as map scale pods surrounded by clastic rocks of Zhe/pl unit. Wortman et al. (2000) report a 615.7+3.7/-1.9 Ma U-Pb zircon date for a dacitic tuff from the unit in the Rougemont quadrangle.

Zhadlt (u) – Andesitic to dacitic lavas and tuffs of the upper portion of the Hyco Formation: Black to dark gray, gray-green to green; aphanitic andesite to dacite and porphyritic andesite to dacite with plagioclase phenocrysts. Hyaloclastic textures are common. Interlayered with the lavas are gray to black, welded and non-welded, coarse tuff, lapilli tuff, and tuff breccia. Rocks interpreted as andesites have distinct interior weathering rind of light brown to gray and fresh surfaces exhibit non-vitric like textures in contrast to dacites.

Zhablt – Andesitic to basaltic lavas and tuffs: Green, gray-green, gray, dark gray and black; typically unfoliated, amygdaloidal, plagioclase porphyritic, amphibole/pyroxene porphyritic and aphanitic; andesitic to basaltic lavas and shallow intrusions. Hyaloclastic texture is common and imparts a fragmental texture similar to a lithic tuff on some outcrops. Locally interlayered with pyroclastic rocks and metasedimentary rocks identical to the Zhe/pl and Zhime/pl units.

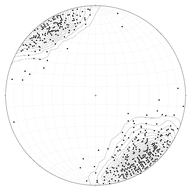
Zhabl - Andesitic to basaltic lavas: Green, gray-green, gray, dark gray and black; typically unfoliated, amygdaloidal, plagioclase porphyritic, amphibole/pyroxene porphyritic and aphanitic, andesitic to basaltic lavas and shallow intrusions. Hyaloclastic texture is common and imparts a fragmental texture on some outcrops and boulders. Conglomeratic rocks containing angular clasts of andesite and/or basalt occur locally and are interpreted as resedimented hyaloclastite.

Zhablc - Andesitic to basaltic lavas and conglomerate: Green, gray-green, gray, dark gray and black; typically unfoliated, amygdaloidal, plagioclase porphyritic, amphibole/pyroxene porphyritic and aphanitic; andesitic to basaltic lavas and shallow intrusions. Hyaloclastic texture is common and imparts a fragmental texture on some outcrops and float boulders. Interlayers of conglomeratic rocks containing angular clasts of andesite and/or basalt are common and are interpreted as resedimented hyaloclastite. Locally interlayered with pyroclastic rocks and metasedimentary rocks identical to the Zhime/pl units.

Zhablt-dcp – Andesite to basalt porphyry of the Dry Creek area: Distinctive, green to dark green, andesite porphyry with aphanitic groundmass and euhedral phenocrysts (up to 10 mm) of greenish-white plagioclase; phenocrysts typically constitute 20 to 50% of the rock; local alignment of plagioclase; lesser pyroxene/amphibole phenocrysts. Green to dark green basalt porphyry with abundant pyroxene (altered to amphibole) phenocrysts with minor plagioclase phenocrysts. Andesite and basalt porphyries locally amygdaloidal (up to 2 cm), amygdules include calcite, quartz, chlorite, and epidote. Same as Dry Creek Porphyry complex of Hauck (1977).

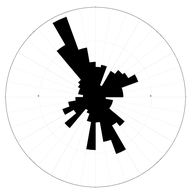
Equal Area Schmidt Net Projections and Rose Diagram

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

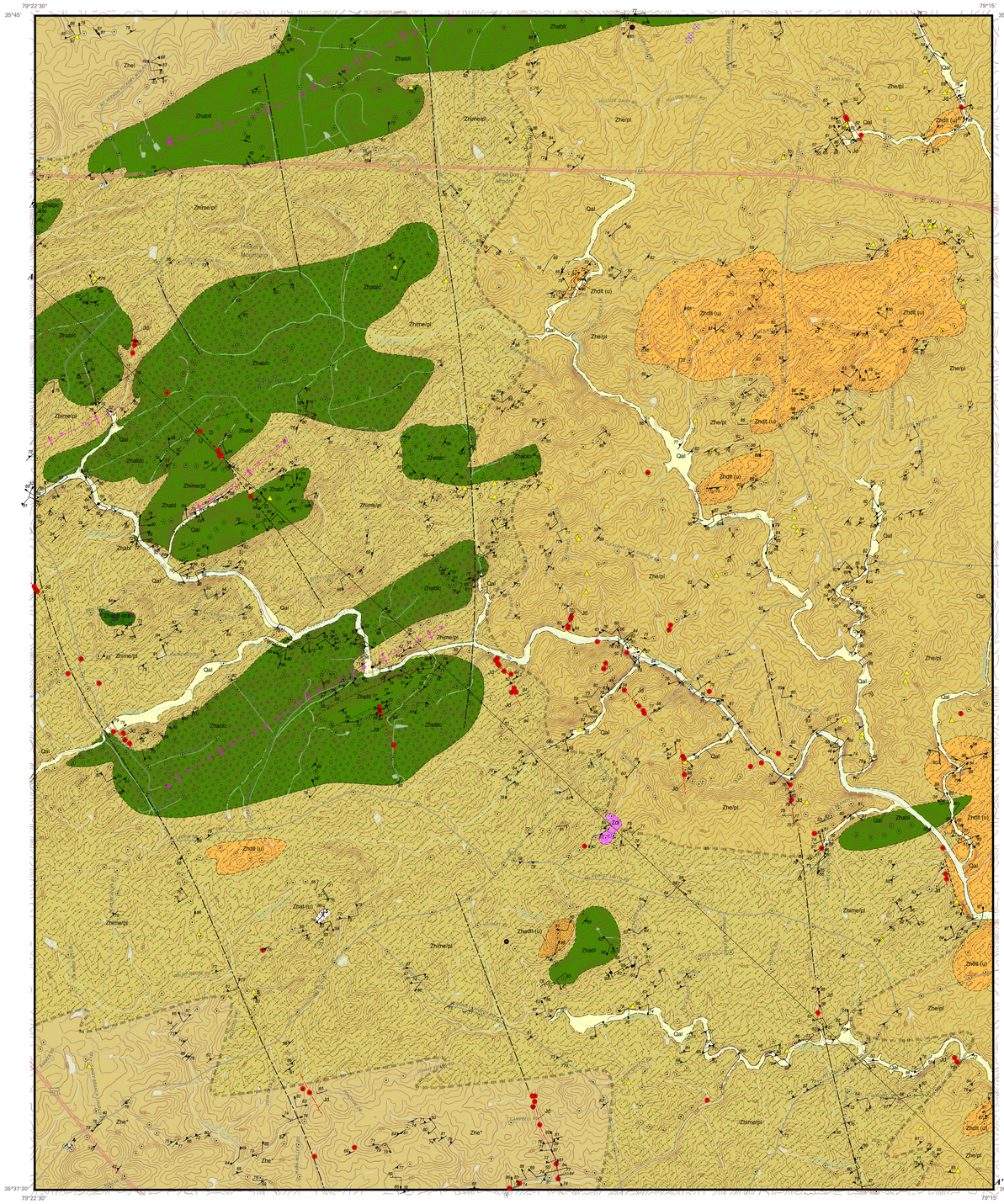


Equal Area Schmidt Net Projection of Contoured Poles to Foliation and Cleavage
Contour Interval = 2 sigma N = 544

Equal Area Schmidt Net Projection of Contoured Poles to Primary Bedding, Layering, and Welding Compaction/Foliation
Contour Interval = 2 sigma N = 46



Unidirectional Rose Diagram of Joints N = 447
Outer Circle = 8%
Mean vector = 8.5 degrees
Max value = 7.6% between 331 degrees and 340 degrees



Topographic base produced by the United States Geological Survey,
Altered by the North Carolina Geological Survey for use with 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, May 2012
Roads.....©2006-2012 TomTom
Names.....GNIS, 2012
Hydrography.....National Hydrography Dataset, 2012
Contours.....National Elevation Dataset, 2008
Boundaries.....Census, IBWL, IBG, USGS, 1972 - 2012?

UTM GRID AND 2013 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

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

SCALE 1:24 000

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

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 0.6.11

QUADRANGLE LOCATION

Crutchfield Crossroads	Silk Hope	Bynum
Siler City	Siler City NE	Pittsboro
Bear Creek	Goldston	Colon

ROAD CLASSIFICATION

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

EXPLANATION OF MAP SYMBOLS

CONTACTS, FAULTS AND OTHER FEATURES

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

- Inferred contact
- Concealed contact
- Gradational contact - inferred
- In cross section, gradational contact - inferred
- In cross section, fold form lines
- In cross section, inferred axial trace of large-scale fold
- A A' Cross section line
- Inferred brittle fault; dotted where concealed
- Interpreted fold hinge of large-scale anticline; question mark where existence is questionable; dotted where concealed; arrow indicates direction of plunge
- Interpreted fold hinge of large-scale syncline; question mark where existence is questionable; dotted where concealed; arrow indicates direction of plunge
- Inferred diabase dike; dotted where concealed.
- Linear geomorphic feature interpreted from hillshade LiDAR - origin uncertain
- Qal contact

- Station location
- Diabase station location
- Station location with conspicuous amounts of quartz cobbles and/or boulders
- Quartz dacite porphyry boulders

PLANAR FEATURES

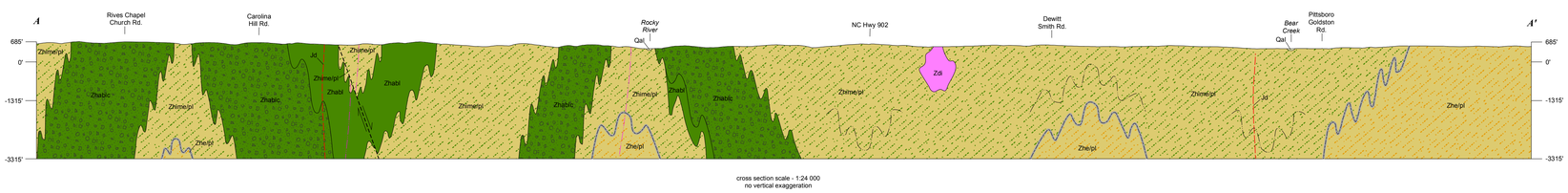
(For multiple observations at one locality, symbols are joined at the "tail" ends of the strike lines)

- Strike and dip of primary bedding and/or layering
- Strike and dip of primary bedding and/or layering (multiple observations at one location)
- Strike and dip of primary volcanic compaction and/or welding foliation
- Strike and dip of inclined regional foliation
- Strike and dip of inclined regional foliation (multiple observations at one location)
- Strike of vertical regional foliation
- Strike and dip of cleavage
- Strike and dip of cleavage (multiple observations at one location)
- Strike and dip of inclined joint surface
- Strike and dip of inclined joint surface (multiple observations at one location)
- Strike of vertical joint surface
- Strike of vertical joint surface (multiple observations at one location)
- Strike and dip of cataclastic cleavage interpreted as a result of brittle deformation (multiple observations at one location)

PROSPECTS AND QUARRIES

X Prospect (pit or small open cut)
1 Graham copper prospect - abandoned (Carpenter, 1976)
2 Prospect pit (copper) - abandoned (USGS - MRDS database)
3 Prospect pit (commodity unknown) - abandoned
5 Prospect pit (commodity unknown) - abandoned
6 Prospect pit (commodity unknown) - abandoned

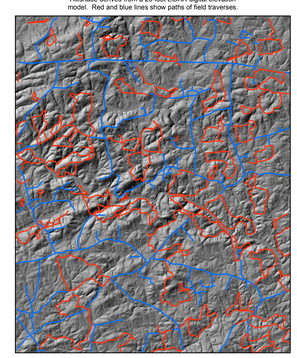
Abandoned quarry
4 Quarry - abandoned



cross section scale - 1:24 000
no vertical exaggeration

TRAVERSE MAP

Hillshade derived from a 20 foot LiDAR digital elevation model. Red and blue lines show paths of field traverses.



by car
by foot

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Geologic Map of the Siler City Northeast 7.5-minute Quadrangle, Chatham County, North Carolina

By
Heather D. Hanna, Philip J. Bradley, and Randy Bechtel

Geologic data collected from July 2014 through May 2015.
Map preparation, digital cartography and editing by
Michael A. Medina, Heather D. Hanna and Philip J. Bradley.
2015

Base map is from USGS 2013 GeoPDF of the Siler City NE 7.5-minute quadrangle.
Air photo, map collar and select features removed. Bounds of GeoPDF based on
7.5-minute grid projection in UTM 17S; North American Datum of 1983 (NAD83).

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.

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