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Division of Energy, Mineral and Land Resources
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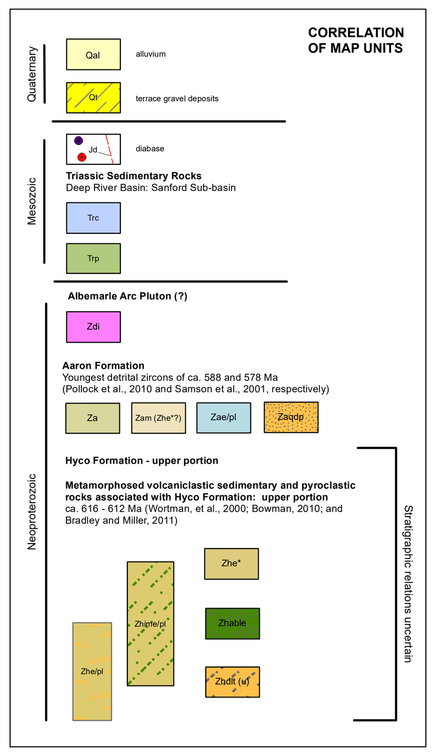


INTRODUCTION

The Bear Creek 7.5-minute Quadrangle lies in the east central-portion of the North Carolina Piedmont. The unincorporated communities of Bear Creek and Harpers Crossroads are present in the quadrangle. Old US HWY 421 crosses the northeast corner, State HWY 902 diagonally cuts across the northern portion, and State HWY 42 cuts across the southern portion of the quadrangle.

Bear Creek controls the drainage in the northern portion of the quadrangle and drains into the Rocky River which is a major tributary of the Deep River. The southern portion of the quadrangle drains directly to the Deep River along named tributaries of Tysons Creek, Indian Creek, Little Indian Creek, Falls Creek and other unnamed tributaries. Natural exposures of crystalline and Triassic rocks primarily occur along these named and unnamed creeks. Rock exposure at road cuts, ridges, resistant finned-shaped outcrops and pavement outcrops locally occur outside of drainages. The elevations in the map area range from approximately 650 feet above sea level on a resistant hill, near the intersection of Siler City – Glendon Road and Providence Church Road, in the northern portion of the quadrangle, to approximately 250 feet along several tributaries draining the southern edge of the quadrangle.

GEOLOGIC BACKGROUND

Pre-Mesozoic crystalline rocks in the Bear Creek 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 and the associated volcanic Virgilina member of the redefined Virgilina sequence (Hibbard et al., 2013). The Hyco Arc consists of the Hyco Formation which include ca. 633 to 612 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 tentatively be divided into lower (ca. 630 Ma) and upper (ca. 615 Ma) portions 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 consists of metamorphosed layered volcaniclastic rocks with youngest detrital zircons of ca. 588 and 578 Ma (Pollock et al., 2010 and Samson et al., 2001, respectively). Hibbard et al. (2013) interprets an at least 24 million year unconformity between the Aaron and underlying Hyco Formation.

FOLDS

The Hyco Arc and Aaron Formation lithologies were folded and subjected to low grade metamorphism during the ca. 578 to 554 Ma (Pollock, 2007; Pollock et al., 2010) Virgilina deformation (Glover and Sinha, 1973; Harris and Glover, 1985; Harris and Glover, 1988; and Hibbard and Samson, 1995). In the map area, original layering of Hyco and Aaron Formation lithologies are observed ranging from shallowly to steeply dipping and are interpreted to be a result of open to tight folds that are locally overturned.

Preliminary stereogram analyses of data from two map scale synclines in the nearby Coleridge Quadrangle (Bradley et al, 2018), appears to indicate the presence of folds ranging from gentle to open. Subsequent domain analyses of primary bedding and layering in Hyco Formation and Aaron Formation units outside of the two synclines, indicate folds range from tight to open with the majority of the folds within the tight to close range. In general, it appears that the Hyco Formation and older portions of the Aaron Formation are more tightly folded compared to the Aaron Formation in the identified synclines in the Coleridge Quadrangle. This apparent range from gentle to tight folds is not well understood and may indicate: 1) normal disharmonic folding due to competency differences between units or 2) indicate that the younger units within the synclines in Coleridge are more appropriately assigned to the Albemarle Arc lithologies and were deposited above an angular unconformity. More investigation is needed.

In southern portion of the Bear Creek Quadrangle, outcrop scale folds (best exposed within the pyrophyllite mines) deform an earlier foliation. This folding is associated with local deformation along several identified high angle reverse faults in the map area (e.g. Glendon Fault).

FAULTS

The Glendon fault, located in the southern edge of the quadrangle, has long been recognized by past workers (e.g. Stuckey, 1928 and Conley, 1962). The Glendon fault is a high angle reverse fault that is a locus of pyrophyllite alteration for a distance of over 30 km (18 miles) in northeast Moore County and into southern Chatham County. The Glendon fault is interpreted to be parallel to the axial surfaces of regional-scale overturned folds and disrupts an anticline near its crest (Green et al., 1982 and Klein, 1985). In general, the Glendon fault is a zone of intense deformation ranging from 10 to 50 meters wide with abundant small-scale folds, fractures and deformed and undeformed quartz veins indicating a complicated movement history (Klein, 1985). Quartz veins may be folded and high strain foliations present within the fault zone overprint and/or transpose primary bedding and regional foliation.

Several other high angle reverse faults with varying degrees of hydrothermal alteration were identified during mapping. Metamorphic foliation data indicates that the dip of the foliation progressively becomes more shallow to the southeast approaching the high angle faults. In the immediate area of the faults, sericite (±phyrophyllite) phyllites and schistose phyllites with composite-like fabrics are common. It is interpreted that the older foliation has been transposed to a younger phyllonitic foliation within the fault zone.

Abundant evidence of brittle faulting at the outcrop-scale, map-scale and 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 to the east of the study area, is a constriction zone in the Deep River Mesozoic basin and is characterized by crystalline rocks overprinted by complex brittle faulting.

PAST WORK

The map area is located within 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. Nixon (1954) mapped portions of the area and investigated the historic copper prospects and mines in the area. Moore (1980) mapped and investigated felsic flows that included a small portion of the southern edge of the quadrangle.

MINERAL RESOURCES

GLENDON PYROPHYLLITE DEPOSITS

There is one active pyrophyllite mine in the quadrangle. Pyrophyllite is used to manufacture a variety of products for the refractory, ceramics and filler industries. The active Standard Minerals Pyrophyllite Mine is located at the southern edge of the quadrangle in Moore County. The area around the active mine is known as the Glendon pyrophyllite deposits and is home to several historic economic deposits of pyrophyllite that were first documented in the early to mid 1800's (Olmstead, 1822 and Emmons, 1856). Stuckey (1928 and 1967) and Conley (1962) conducted investigations into the structure and characteristics of the deposits. McDaniel (1976) and Spence (1975) interpreted the origin of the pyrophyllite deposits as being related to ancient hydrothermal (hot spring) activity. Klein (1985), as part of a detailed field trip guide, described aspects of the geology, mineralogy and structure of the Glendon pyrophyllite deposits.

The Glendon pyrophyllite deposits consist of four mines, from southwest to northeast include; Bates (inactive), Phillips (inactive), Womble (active Standard Minerals mine) and White (inactive for pyrophyllite) Mines. The inactive Bates mine is in the quadrangle immediately to the south. Some of the early mining in the Glendon area was underground; mining is presently from open pits. The mines are located along the Glendon fault (Stuckey, 1928 and Conley, 1962).

GOLD-PYROPHYLLITE BELT IN MOORE COUNTY

Lesure (1981) presented the results from a geochemical reconnaissance study from old gold mines, pyrophyllite deposits and road outcrops throughout northwestern Moore County. One hundred and ninety (190) of the rock samples contained gold in quantities ranging from 0.02 to 2.4 ppm. Twenty-six (26) samples were collected from the Glendon pyrophyllite deposits and vicinity with gold values ranged from 0.02 to 0.04 ppm.

COPPER MINES AND PROSPECTS

Several historic copper deposits are present in southwestern Chatham County. In the Bear Creek Quadrangle, the copper deposits include several prospects and small mines including; the Barringer Phillips Prospect, the Bear Creek Mine and Phillips Mine. More detailed descriptions of the deposits are provided in Berry (1943), Nixon (1954) and Carpenter (1976). The Barringer Phillips Prospect consisted of two pits now filled in. The Bear Creek Copper Mine was worked in the 1940's with several tons of ore removed and has an abandoned shaft up to 32 feet deep. The Phillips Mine was also worked in the 1940's with several hundred tons of ore removed with subsequent exploration and collection of rock core; a water filled pit is all that is left of the workings. Copper minerals reported include: chalcopyrite, bornite, chalcocite, malachite and azurite.

The Haw Branch Copper Deposit in Moore County was briefly described by Conley (1962) and was investigated by Powers (1985). The prospect consists of several pits, shafts and a trench. Powers (1985) conducted geologic mapping, fluid inclusion studies, a geochemical traverse and electrical resistivity traverse of the deposit. Additional work in the Haw Branch Copper deposit area was conducted in 1993 (Powers, 1993).

DESCRIPTION OF MAP UNITS

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 or 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. Dikes of Jurassic aged diabase intrude the crystalline rocks of the map area. Jurassic diabase dikes are not metamorphosed. Quaternary aged alluvium is present in most major drainages.

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 is interpreted to represent dacitic domes and proximal pyroclastics. The andesitic to basaltic lavas (with tuffs or conglomerates) units are interpreted to represent eruption of intermediate to mafic lava flows and associated pyroclastic and/or epiclastic deposits. The epiclastic/pyroclastic 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 is needed to confirm this interpretation. A review of the regional lithologies is summarized in Bradley (2013).

A preliminary review of the area geology is provided in Bradley (2013). Unit descriptions common to Bradley et al. (2017) and Hanna et al. (2015) from the Siler City and Siler City NE geologic maps, respectively were used for conformity with on strike units in neighboring quadrangles. Unit descriptions and stratigraphic correlations were maintained from adjacent mapping in Orange County (Bradley et al., 2016). 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 is available. Pyroclastic rock terminology follows that of Fisher and Schminke (1984).

Sedimentary Units

Qal

Qal – Alluvium: Unconsolidated poorly sorted and stratified deposits of angular to subrounded clay, silt, sand and gravel- to boulder-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.

Qt

Qt – Terrace deposits: Unconsolidated clay, silt, sand, gravel, and cobbles above current floodplain level; gravel- and cobble-sized material are typically composed of subrounded to subangular quartz clasts. Reinemund (1955) identifies four terrace deposits in the Deep River area distinguished on their occurrence at specific elevations.

Trp

Trp – Pekin Formation: Gray, brown to maroon, white mica bearing, interbedded mudstones, siltstones and arkosic sandstones. Outcrops and boulders of float identified as part of Pekin Formation are strongly indurated compared to conglomerates identified as part of Chatham Group. Identified as the Pekin Formation by Reinemund (1955).

Trc

Trc – Cumnock Formation: Gray and black claystone, shale and siltstone. Gray sandstone and conglomerate. Contains beds of coal and carbonaceous shale (Reinemund, 1955). Exposures of the Cumnock Formation were not encountered during field mapping. Area of Cumnock included on map to edge match with historic data.

Intrusive and Metaintrusive Units

Jd

Jd – Diabase: Black to greenish-black, fine- to medium-grained, dense, consists primarily of plagioclase, augite and may contain olivine. Locally has gabbroic texture. 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. Purple station locations indicate outcrop or boulders of gabbroic textured diabase.

Zdi

Zdi – Diorite: Mesocratic (CI~50), greenish-gray to grayish-green, fine- to medium-grained, metamorphosed, 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. Gabbro intermingled locally.

Metavolcanic and Metavolcaniclastic Units

Aaron Formation

Zae/pl

Zae/pl – Aaron Formation (Virgilina member) mixed epiclastics, pyroclastics and lavas of the Devils Tramping Ground area: Grayish-green to greenish-gray, metamorphosed tuffaceous sandstones, conglomeratic sandstones, siltstones and minor phyllite. The siltstones typically are weakly phyllitic. Contains lesser amounts of fine- to coarse tuff, welded tuff and dacitic lavas. Fiamme-like shaped clasts are common in the conglomerates, sandstones and tuffs. Quartz and feldspar crystal fragments are common in the sedimentary components, tuffs and lavas. Silicified and/or sericitized altered rock and quartz with adularia are locally present. Unit is interpreted to be in gradational contact with unit Za. Contact with unit Za designated at first occurrence of sandstones with angular clasts or primary volcanic rocks.

Zaqdp

Zaqdp - Quartz dacite porphyry: 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. Similar to quartz dacite porphyry unit within the Bynum Quadrangle (Bradley et al., 2013).

Za

Za – Aaron Formation: Distinctive metasedimentary package that ranges from fine-grained siltstones to coarse-grained sandstones, pebbly sandstones and conglomerates. Siltstones are similar in appearance to Hyco Formation lithologies. The sandstones, pebbly sandstones and conglomerates (classified as litharenite, feldspathic litharenite and lithic feldsarenite by Harris (1984)) are distinctive and commonly contain rounded to subrounded clasts of quartz ranging from sand- to gravel-sized. In the sandstones, feldspar is the most prominent mineral grain; quartz varies from sparse to abundant in hand sample. Lithic clasts are typically prominent and range from sand- to gravel-size. Harris (1984), performed a detailed sedimentary study of the Aaron Formation to the immediate west of the map area. Harris (1984) interpreted the Aaron Formation to have been deposited by turbidity currents in a retrogradational submarine fan setting.

Zam (Zhe*?)

Zam (Zhe*?) – Aaron Formation mudstones (possible Hyco Formation mudstones): Distinctive thinly bedded to very thinly bedded siltstones and mudstones. Aaron Formation mudstones are distinguished from Hyco Formation mudstones by the presence of interlayered quartz bearing sandstones in the Aaron. Without the presence of the distinguishing quartz bearing interlayers, this unit is tentatively assigned to the Aaron Formation.

Hyco Formation – Upper Portion

Zhe*

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 (greywacke). 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.

Zhime/pl

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; metamorphosed: 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 the Zhable unit. 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 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.

Zhdlt (u)

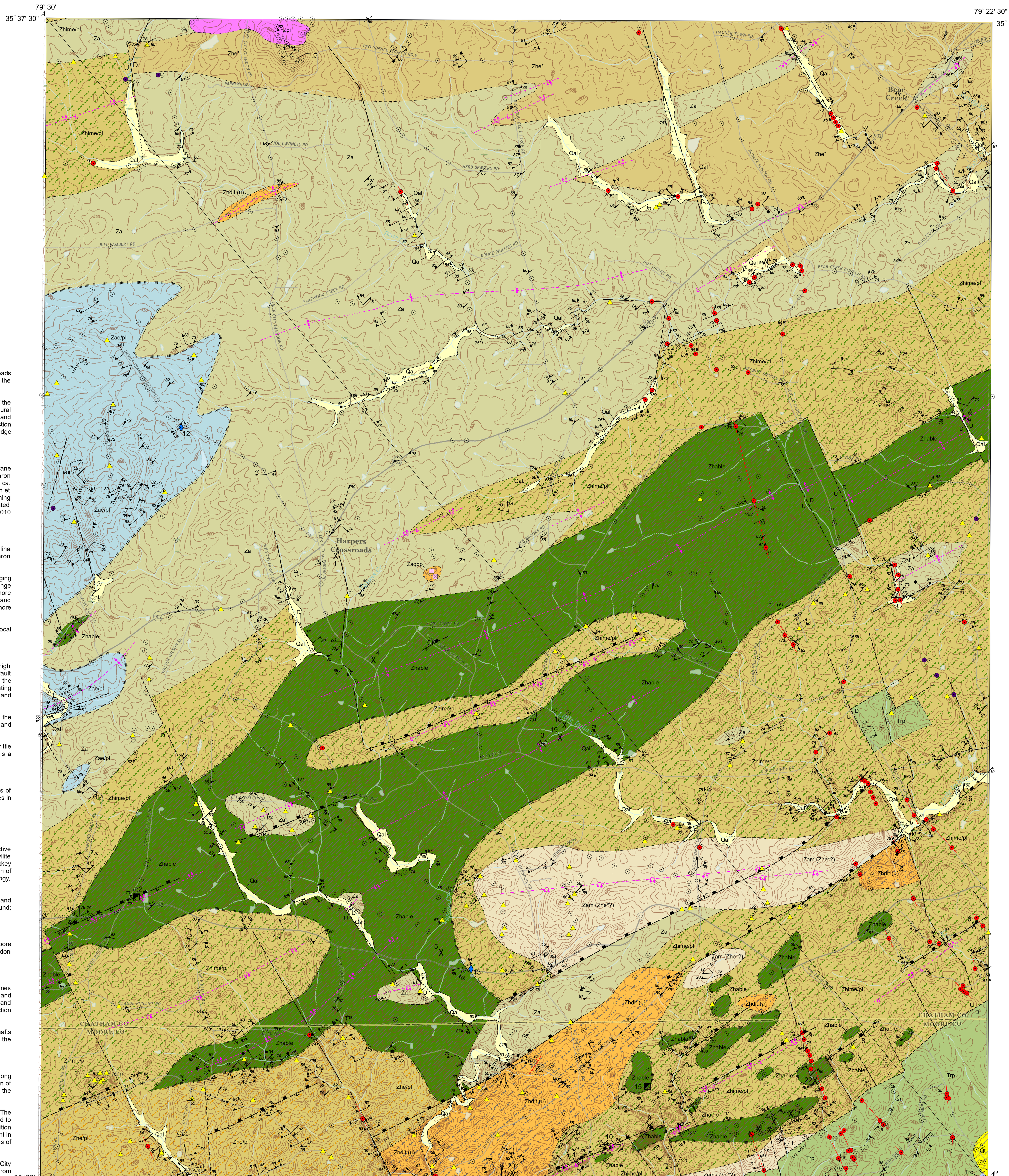
Zhdlt (u) – Dacitic lavas and tuffs of the upper portion of the Hyco Formation: Greenish-gray to dark gray, siliceous, metamorphosed: aphanitic dacite, porphyritic dacite with plagioclase phenocrysts, and flow banded dacite. Dacite with hyaloclastic textures are common. Welded and non-welded tuffs associated 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. Wortman et al. (2000) reports an age of 615.7+3.7/-1.9 Ma U-Pb zircon date for a dacitic tuff from the unit in the Rougemont quadrangle.

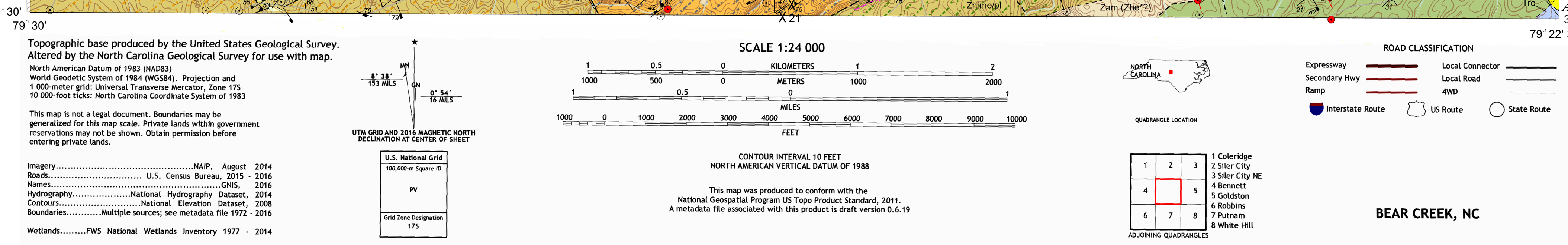
Zhable

Zhable – Andesitic to basaltic lavas with interlayered epiclastic rocks: Light green, gray-green, gray, and dark gray; typically unfoliated, amygdaloidal, plagioclase porphyritic, amphibole/pyroxene porphyritic and aphanitic; metamorphosed: andesitic to basaltic lavas and shallow intrusions. Hyaloclastic texture is common and imparts a fragmental texture on some outcrops and float boulders. Contains lesser amounts of grayish-green, light green, and light gray to white; metamorphosed conglomerate, conglomeratic sandstone, sandstone, siltstone and mudstone.

Zhe/pl

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; metamorphosed: 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 (not present in quadrangle). 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 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.





EXPLANATION OF MAP SYMBOLS

CONTACTS, FAULTS, AND OTHER FEATURES

inferred contact

concealed contact

gradational contact - inferred; dotted where concealed

inferred brittle fault; dotted where concealed; D indicates downthrown side, U indicates upthrown side

reverse fault - inferred; queried where questionable

quaternary alluvium contact

linear geomorphic feature interpreted from hillshade LiDAR - origin uncertain

inferred diabase dike; dotted where concealed

interpreted fold hinge of anticline; dotted where concealed

interpreted fold hinge of syncline; dotted where concealed

interpreted fold hinge of overturned anticline

interpreted fold hinge of overturned syncline; queried where questionable

A A' cross section

IN CROSS SECTION

inferred contact

inferred gradational contact

brittle fault (arrows indicate direction of motion)

inferred fold axis

PLANAR AND LINEAR FEATURES

74 strike and dip of primary bedding and/or layering

60 70 strike and dip of primary bedding and/or layering (multiple observations at one location)

78 strike and dip of primary volcanic compaction and/or welding foliation

69 strike and dip of inclined regional foliation

81 84 strike and dip of inclined regional foliation (multiple observations at one location)

56 strike and dip of shear foliation

64 strike and dip of shear foliation (multiple observations at one location)

77 strike and dip of cleavage

75 84 strike and dip of cleavage (multiple observations at one location)

71 strike and dip of inclined joint surface

19 strike and dip of slickenside (multiple observations at one location)

19 strike and dip of axial surface (multiple observations at one location)

strike of vertical joint surface

78 82 strike and dip of inclined joint surface (multiple observations at one location)

strike of vertical joint surface (multiple observations at one location)

65 strike and dip of quartz vein

56 clast lineation

63 trend and plunge of crenulation lineation

14 trend and plunge or slickenline

PROSPECTS AND QUARRIES

prospect (pit or small open cut)
- 1 Roads Prospect – copper (USGS, MRDS); Not confirmed by NCGS
- 4 prospect – unknown commodity (identified by Nixon, 1954); Not confirmed by NCGS
- 5 Barringer Phillips Prospect – copper (USGS, MRDS; Carpenter, 1976)
- 6 Oldham Pyrophyllite Pit – pyrophyllite (Reinemund, 1955); approximate location
- 7 Jones Pyrophyllite Pit - pyrophyllite (Reinemund, 1955); approximate location from Powers (1993)
- 8 Currie Pyrophyllite Pit - pyrophyllite (Reinemund, 1955); approximate location
- 14 Haw Branch Copper Deposit – copper (Powers, 1985); multiple points
- 18 prospect pit – copper
- 19 prospect pit – copper
- 20 prospect pit – pyrophyllite
- 21 prospect pit – pyrophyllite
- 22 prospect pit – pyrophyllite

quarry or mine - active
- 10 Standard Minerals (Womble) Pyrophyllite Mine - pyrophyllite

quarry or mine - abandoned
- 3 Phillips Mine – copper (USGS, MRDS; Carpenter, 1976; Nixon, 1954)
- 9 White (Snow) Pyrophyllite Mine - pyrophyllite (Reinemund, 1955)
- 11 Phillips Pyrophyllite Mine - pyrophyllite
- 16 unnamed quarry/pit – flagstone

borrow pit - abandoned
- 17 unnamed borrow pit – fill material

mine shaft - abandoned
- 2 Bear Creek Mine – copper (USGS, MRDS; Carpenter, 1976; Nixon, 1954)
- 15 prospect – abandoned shaft – copper (Powers, personal communication)

OTHER FEATURES

observation station location

indicates location of quartz dacite porphyry boulders or outcrop

indicates location of vuggy and/or massive quartz float

diabase station location

indicates location of gabbroic diabase boulders or outcrop

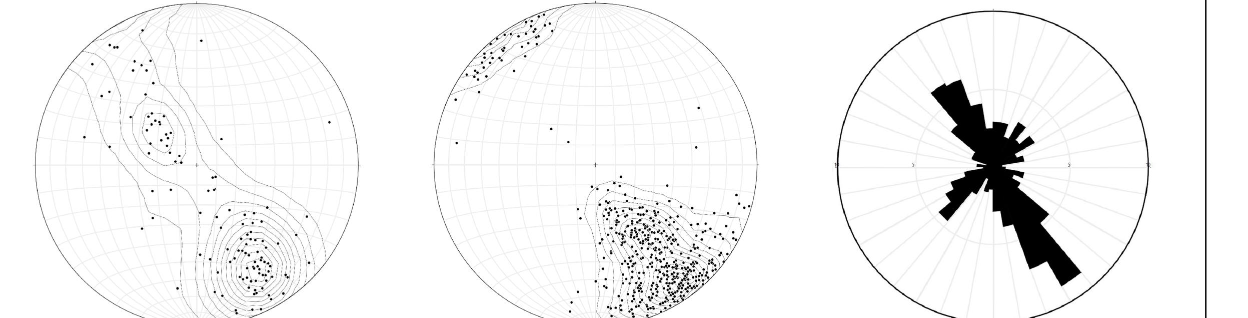
Geochemical sample location
- 12 Nd isotope analysis HOC92-7 (Samson et al., 1995)
- 13 Nd isotope analysis HOC92-8 (Samson et al., 1995)

REFERENCES:

Abdelzahir, A.M., 1978, The geology of the Carolina slate belt, northern Moore County, North Carolina, unpublished M.S. thesis, North Carolina State University, Raleigh, North Carolina, 67 p.
Allmendinger, R. W., Cardozo, N. C., and Fisher, D., 2013, Structural Geology Algorithms: Vectors and Tensors: Cambridge, England, Cambridge University Press, 289 pp.
Berry, E.W., 1943, The copper prospects of Chatham County: North Carolina Department of Conservation and Development, Division of Mineral Resources, Report of Investigation – The Copper Prospects of Chatham County, R.I. 43, 8p.
Bowman, J.D., 2010, The Aaron Formation: Evidence for a New Lithotectonic Unit in Carolinia, North Central North Carolina, unpublished M.S. thesis, North Carolina State University, Raleigh, North Carolina, 116 p.
Bradley, P.J., and Miller, B.V., 2011, New geologic mapping and age constraints in the Hyco Arc of the Carolina terrane in Orange County, North Carolina: Geological Society of America Abstracts with Programs, Vol. 43, No. 2.
Bradley, P.J., 2013, The Carolina terrane on the west flank of the Deep River Basin in the northern Piedmont of North Carolina – A Status Report, in Hibbard, J.P. and Pollock, J.C. editors, 2013, One arc, two arcs, old arc, new arc: The Carolina terrane in central North Carolina, Carolina Geological Society field trip guidebook, pp. 139-151.
Bradley, P.J., Hanna, H.D., Gay, N.K., Stoddard, E.F., Bechtel, R., Phillips, C.M., and Fuemmeler, S. J, 2016, Geologic map of Orange County, North Carolina: North Carolina Geological Survey Open-file Report 2016-05, scale 1:50,000, in color.
Bradley, P.J., Peach, B.T. and Hanna, H.D 2017, Geologic map of the Siler City 7.5-Minute Quadrangle, Chatham County, North Carolina: North Carolina Geological Survey Open-file Report 2017-07, scale 1:24,000, in color (Supersedes Open-file Report 2016-08).
Bradley, P.J, Peach, B.T. and Hanna, H.D., 2018, Geologic map of the Chatham County portion of the Coleridge 7.5-minute Quadrangle, Chatham and Randolph Counties, North Carolina: North Carolina Geological Survey Open-file Report 2018-03, scale 1:24,000, in color. (Supersedes Open-file Report 2016-11).
Cardozo, N., and Allmendinger, R. W., 2013, Spherical projections with OSXStereonet: Computers and Geosciences, v. 51, no. 0, p. 193 - 205, doi: 10.1016/j.cageo.2012.07.021
Carpenter, P. Albert III., 1976 (reprinted 1993), Metallic mineral deposits of the Carolina Slate, North Carolina Geological Survey, Bulletin 84, 89p.
Conley, J.F., 1962, Geology and mineral resources of Moore County, North Carolina: Division of Mineral Resources, North Carolina Department of Conservation and Development, Bulletin 76, 40 p.
Emmons, E., 1856, Geological Report of the Midland Counties of North Carolina: North Carolina Geological Survey, Miscellaneous Publication.
Fisher, R.V., and Schmincke H.-U., 1984, Pyroclastic rocks, Berlin, West Germany, Springer-Verlag, 472 p.
Glover, L., and Sinha, A., 1973, The Virgilina deformation, a late Precambrian to Early Cambrian (?) orogenic event in the central Piedmont of Virginia and North Carolina, American Journal of Science, Cooper v. 273-A, pp. 234-251.
Green, G., 1977, The geology of the slate belt rocks of the Goldston and Bear Creek quadrangles, North Carolina, un-published M.S. thesis, North Carolina State University, Raleigh, North Carolina, 68 p.
Green, G., Cavaroc, V., Stoddard, E., Abdelzahir, A., 1982, Volcanic and volcaniclastic facies in a part of the slate belt of North Carolina, In: Bearce, D., Black, W., Kish, S., Tull, J. (Eds.), Tectonic studies in the Talladega and Carolina slate belts, Southern Appalachian Orogen. Geological Society of America Special Paper, vol. 191, pp.109– 124.
Hanna, H.D., Bradley, P.J., and Bechtel, R., 2015, Geologic Map of the Siler City NE 7.5 Minute Quadrangle, Chatham County, North Carolina: North Carolina Geological Survey Open-file Report 2015-02, scale 1:24,000, in color.
Harris, C.W., 1984, Coarse-grained submarine-fan deposits of magmatic arc affinity in the late Precambrian Aaron Formation, North Carolina, U.S.A., Precambrian Research, 26, pp. 285-306.
Harris, C., and Glover, L., 1985, The Virgilina deformation: implications of stratigraphic correlation in the Carolina slate belt, Carolina Geological Society field trip guidebook, 36 p.
Harris, C., and Glover, 1988, The regional extent of the ca. 600 Ma Virgilina deformation: implications of stratigraphic correlation in the Carolina terrane, Geological Society of America Bulletin, v. 100, pp. 200-217.
Hibbard, J., and Samson, S., 1995, Orogenesis exotic to the Iapetan cycle in the southern Appalachians, In, Hibbard, J., van Staal, C., Cawood, P. editors, Current Perspectives in the Appalachian– Caledonian Orogen. Geological Association of Canada Special Paper, v. 41, pp. 191–205.
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.
Hibbard, J. P., van Staal, C. R., Rankin, D. W., and Williams, H., 2006, Lithotectonic map of the Appalachian Orogen, Canada-United States of America, Geological Survey of Canada, Map-2096A. 1:1,500,000-scale.
Hibbard, J.P., Pollock, J.C., and Bradley, P.J., 2013, One arc, two arcs, old arc, new arc: An overview of the Carolina terrane in central North Carolina, Carolina Geological Society field trip guidebook, 265 p.
Klein, T.L., 1985, Glendon Pyrophyllite deposits – Stops 2-10, in Feiss, P.G., editor, Volcanic-hosted gold and high-alumina rocks of the Carolina slate belt, guidebook for the field trip held in conjunction with the 1985 fall meeting of the Society of Economic Geologists and the 1985 annual meeting of the Geological Society of America, Orlando, Florida, p. 48-72.
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.
Lesure, F.G., 1981, Map showing reconnaissance geochemistry in the gold-pyrophyllite belt of northwestern Moore County, North Carolina: U.S. Geological Survey, Miscellaneous Field Studies Map MF-1301, scale 1:48000.
McDaniel, R.D., 1976, Application of hot spring-fumerole alteration model to the genesis of the pyrophyllite deposits of the Carolina slate belt, unpublished M.S. thesis, North Carolina State University, Department of Geosciences, Raleigh, North Carolina, 75 p.
Moore, B.R., 1980, Investigations of a felsic flow, northern Moore County, North Carolina, unpublished M.S. thesis, North Carolina State University, Raleigh, North Carolina 70 p.
Nixon, E.C., 1954, Geology of the Harpers Crossroads area, southwestern Chatham County, North Carolina: Unpublished M.S. Thesis, North Carolina State College, Raleigh, 39 p.
Olmstead, D., 1822, On the gold mines of North Carolina, American Journal of Science, v.9, p.5-15.
Pollock, J. C., 2007, The Neoproterozoic-Early Paleozoic tectonic evolution of the peri-Gondwanan margin of the Appalachian orogen: an integrated geochronological, geochemical and isotopic study from North Carolina and Newfoundland. Unpublished PhD dissertation, North Carolina State University, 194 p.
Pollock, J.C., Hibbard, J.P., and Sylvester, P.J., 2010, Depositional and tectonic setting of the Neoproterozoic-early Paleozoic rocks of the Virgilina sequence and Albemarle Group, North Carolina: in Tollo, R.P., Bartholomew, M.J., Hibbard, J.P., and Karabinos, P.M., eds., From Rodinia to Pangea: The Lithotectonic Record of the Appalachian Region: Geological Society of America Memoir 206, p. 739-772.
Powers, J.A., 1985, Mineralization and alteration associated with breccia pipe structures, Haw Branch Copper Deposit, Moore County, North Carolina, unpublished M.S. thesis, North Carolina State University, Raleigh, North Carolina, 105 p.
Powers, J.A., 1993, Manuscript map of the Rodger's Creek project, Chatham and Moore Counties, Bear Creek 7.5 minute quadrangle, scale: 1 inch = 500 feet, unpublished data.
Reinemund, J.A., 1955, Geology of the Deep River coal field, North Carolina: U.S. Geol. Survey Prof. Paper 246, 159 p.
Samson, S., Hibbard, J., and Wortman, G., 1995, Nd isotopic evidence for juvenile crust in the Carolina terrane, southern Appalachians: Contributions to Mineralogy and Petrology, v. 121, p. 171-184.
Samson, S.D., Secor, D.T, and Hamilton, M.A., 2001, Wandering Carolina: Tracking exotic terranes with detrital Zircons, GSA Abstracts with Programs Vol. 33, No. 6, p. A-263.
Spence, W.H., 1975, A model for the origin of the pyrophyllite deposits in the Carolina slate belt (abstract.). Geological Society of America Abstracts with Programs, v. 7, 536 p.
Stuckey, J.L., 1928, Pyrophyllite deposits of North Carolina: North Carolina Department of Conservation and Development, Bulletin 37, 62 p.
Stuckey, J.L., 1967, Pyrophyllite Deposits in North Carolina: North Carolina Geological Survey, Bulletin 80, scale 1:500,000.
Tadlock, K.A., and Loewy, S.L., 2006, Isotopic characterization of the Farrington pluton: constraining the Virgilina orogeny, in Bradley, P.J., and Clark, T.W., editors, The Geology of the Chapel Hill, Hillsborough and Efland 7.5-minute Quadrangles, Orange and Durham Counties, Carolina Terrane, North Carolina, Carolina Geological Society Field Trip Guidebook for the 2006 annual meeting, pp. 17-21.
Wortman, G.L., Samson, S.D., and Hibbard, J.P., 2000, Precise U-Pb zircon constraints on the earliest magmatic history of the Carolina terrane, Journal of Geology, v. 108, pp. 321-338.

Equal-Area Schmidt Net Projections and Rose Diagram

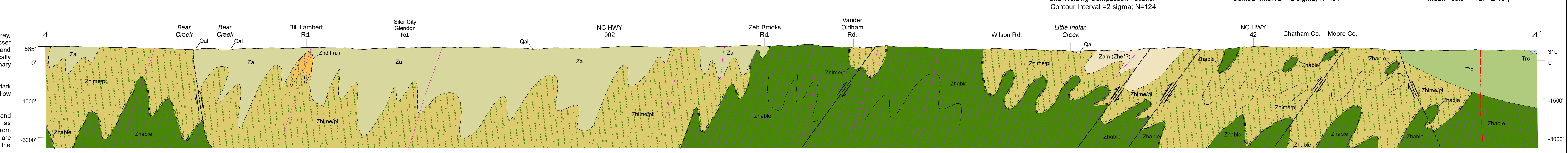
Plots and calculations created using Stereonet v. 10.2.0 based on Allmendinger et al. (2013) and Cardozo and Allmendinger (2013).



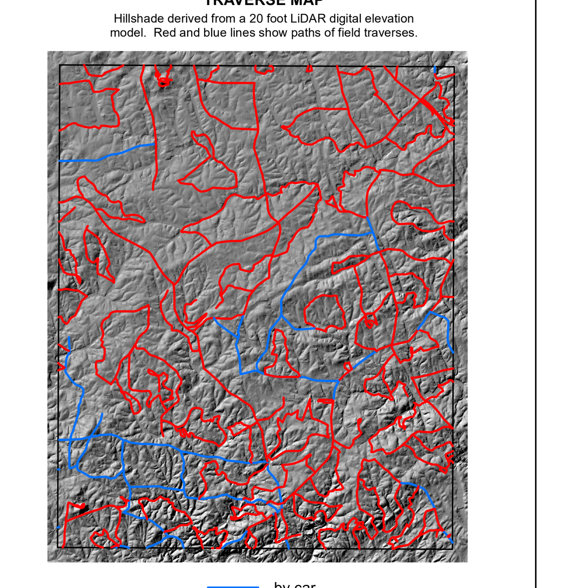
Equal Area Schmidt Net Projection of Contoured Poles to Primary Bedding, Layering and Welding/Compaction Foliation Contour Interval =2 sigma; N=124

Equal Area Schmidt Net Projection of Contoured Poles to Foliation and Cleavage Contour Interval = 2 sigma; N=494

Unidirectional Rose Diagram of Joints N=488 Outer Circle = 10% Mean vector = 127° ± 43°;



cross section scale - 1:24,000 no vertical exaggeration



Geologic Map of the Bear Creek 7.5-Minute Quadrangle, Chatham and Moore Counties, North Carolina.

By
Philip J. Bradley, Aaron K. Rice and Brandon T. Peach

Geologic data collected in June 2017 through May 2018.

Map preparation, digital cartography and editing by
Michael A. Medina, Philip J. Bradley, Aaron K. Rice and Brandon T. Peach.

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Geologic data collected in June 2017 through May 2018 and June 2018 through May 2019.

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