

**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. Bear Creek drains to the Rocky River. The Rocky River 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 linear-shaped outcrops and pavement outcrops locally occur outside of drainages. The exposures in the map area range from approximately 650 feet above sea level to a roadcut 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 the two lithotectonic units, 1) the Hyco Arc and 2) the Aaron Formation and the associated volcanic Virginia member of the redefined Virginia sequence (Hibbard et al., 2013). The Hyco Arc consists of the Hyco Formation which includes ca. 620 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 (informal) with an apparent intervening hiatus of magmatism. In northeastern Chatham County, Hyco Formation units are attributed by the ca. 573 Ma (Tadlock and Lowey, 2000) 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).

**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) Virginia deformation (Glover and Strick, 1973; Harris and Glover, 1985; Harris and Glover, 1986; 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.

Four hundred and seven (407) primary bedding, layering and compaction/welding foliation measurements from this and adjacent quadrangles in the immediate area of the map were used in stereonet analyses to determine the range of fold interlimb angles. Calculated interlimb angles range from greater than 120 degrees to less than 30 degrees indicating the presence of gentle to tight folds. Preliminary domain analyses of measurements in Aaron Formation units only indicate the folds range from tight to open with the majority of the folds within the tight to close range. Preliminary domain analyses of measurements in Aaron Formation units only indicate the folds range from tight to gentle with the majority of the folds within the open range.

**PAST WORK**

The map area is located within the study area of Green et al. (1982), Abdelzahr (1978), and Green (1977). Their studies documented the presence of an overlapping series of metamorphic and metavolcanic lithologies scattered from distal areas. Nixon (1954) mapped portions of the area and investigated the hydrothermal 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.

Abundant evidence of brittle faulting at the outcrop 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, 1956), located to the east of the study area, is a construction zone in the Deep River Mesozoic basin and is characterized by crystalline rocks overlain by complex brittle faulting. Dikes of Jurassic aged diabase intrude the crystalline rocks of the map area. Quaternary aged alluvium is present in most major drainages.

**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 (Olmsted, 1822 and Emmons, 1856). Stucky (1923 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. Kien (1986), 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), Wormlie (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 (Stucky, 1923 and Conley, 1962). The Glendon fault is a high angle (vertical) fault that is a locus of pyrophyllite alteration for a distance of over 30 km (18 miles) in northeast Moore County and into and across Chatham County. The Glendon fault is interpreted to be parallel to the axial surfaces of regional-scale overturned folds and disrupts an antiform near its crest (Green et al., 1982 and Kien, 1986). In general, the fault is a zone of intense deformation ranging from 10 to 50 meters wide with well developed quartz veins, fractured and deformed and undeformed quartz veins, indurated and conglomeratic movement history (Kien, 1986). Quartz veins may be folded and high strain foliations present within the fault zone overlap and/or transpose primary bedding and regional foliation. Northwest-trending faults of probable Mesozoic age cut the Glendon fault.

**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 northwest Moore County. One hundred and ninety (190) of the rock samples contained gold in quantities ranging from 0.02 to 4.4 ppm. Twenty-two (20) 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 (located in the Bear Creek Copper Mine) was worked in the 1840'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: chalcophyllite, bornite, chalcocite, malachite and azurite.

**DESCRIPTION OF MAP UNITS**

All pre-Mesozoic rocks in the map area were not 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. Jurassic diabase dikes are unmetamorphosed.

Map units of metamorphic and metavolcanic rocks include various lithologies that when grouped together are interpreted to indicate general environments of deposition. The dacitic lavas and tuffs are interpreted to represent dacitic domes or asphyxiated vented, boulders with a gray-brown matrix with tuffs or conglomerates units are interpreted to represent eruption of intermediate to mafic lava flows and associated pyroclastic and/or epiclastic deposits. The epistatoclastic units are interpreted to represent deposition from the erosion of dacitic domes. Some volcaniclastic units within the map area are dacitic in nature. Some volcaniclastic units similar to dated units present in northern Orange and Durham Counties. Due to these similarities, the metamorphic and metavolcanic units have been tentatively separated into upper and lower portions of the Hyco Formation; geochronologic data in this 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 conform 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 sediment mapping in Orange County (Bradley et al., 2016). The nomenclature of the International Union of Geological Sciences subcommission on igneous rock nomenclature (IUGS) after Le Maître (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 Schminse (1984).

**Sedimentary Unit**

**Gal - 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 Gal represent outcrops of crystalline rock viters surrounded by alluvium.

**Intrusive and Metaintrusive Units**

**Jd - Diabase:** Black to brownish-black, fine- to medium-grained, dense, consists primarily of plagioclase, augite and may contain olivine. Lacks gabbroic texture. Occurs as dikes up to 100 ft wide. Diabase typically occurs as asphyxiated vented, boulders with a gray-brown matrix with tuffs or conglomerates units. Reel shape indicates outcrop or boulders of diabase. Purple stippling indicates outcrops or boulders of gabbroic textured diabase.

**Za - Diorite:** Mesozoic (C1-50), greenish-gray to grayish-green, fine- to medium-grained, metamorphosed, hydromorphic 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 interbedded locally.

**Metavolcanic and Metavolcaniclastic Units**

**Aaron Formation**

**Za<sup>u</sup> - Aaron Formation (Virginia member):** Mixed epiclastic, pyroclastic and lavas of the Devils Trench Ground area: Grayish-green to greenish-gray, metamorphosed tuffaceous sandstones, conglomeratic sandstones, siltstones and minor phyllite. Contains lesser amounts of fine- to coarse tuff, welded tuff and dacitic lavas. Flame-like shaped clasts are common in the conglomeratic sandstones and tuffs. Quartz and feldspar crystal fragments are common in the sedimentary components, tuffs and lavas. Silicified and/or sericitized altered rock with radiolaria and 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 of primary volcanic rocks.

**Za<sup>z</sup> - 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 (blue) quartz. Phenocrysts typically constitute 20 to 25% of the rock. May locally have fine-grained intrusive texture and may have flow or shallow intrusions possibly associated with domes. Similar to quartz dacite porphyry unit within the Byrum Quadrangle (Bradley et al., 2013).

**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 siltic feldspathic) 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-sized. 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. Pollock et al. (2010) interprets an approximate 35 million year unconformity between the Aaron and underlying Hyco Formation. This interpretation is based in part on detrital zircon age data from an Aaron conglomerate sample collected in the nearby Liberty Quadrangle.

**Hyco Formation - Upper Portion**

**Zh<sup>u</sup> - 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 radiolaria 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.

**Zh<sup>m</sup> - Mixed intermediate to mafic epiclastic-pyroclastic rocks with intertended intermediate to mafic lavas:** Grayish-green to green, locally with distinctive reddish-gray or maroon to lavender coloration, metamorphosed conglomeratic sandstones, siltstones, sandstone 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 Zh<sup>u</sup> unit. Contains lesser amounts of fine- to coarse tuff and lapilli tuff with a cryptocrystalline-like groundmass. Pyroclastic 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 dacitic matrix. Generally interpreted to have been deposited proximal to active volcanism; mafic composition volcanic centers and/or record the erosion of proximal intermediate to mafic composition volcanic centers after cessation of activity.

**Zh<sup>l</sup> (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 hyalitic textures are common. Welded and non-welded tuffs interbedded 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 cone formation. The tuffs are interpreted as episodic pyroclastic flow deposits, at fall tuffs or pyroclastic 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 dacite tuff from the unit in the Rougemont quadrangle.

**Zh<sup>h</sup> - Andesitic to basaltic lavas with intertended epiclastic rocks:** Light green, gray-green, gray, and dark gray; typically unfoliated, amygdaloidal, plagioclase porphyritic, amphibole-pyroxene porphyritic and aphanitic; andesitic to basaltic lavas and shallow intrusions. Hyalitic textures are 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.

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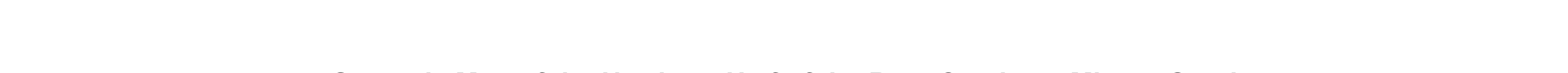
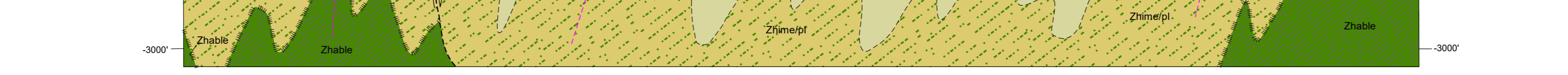
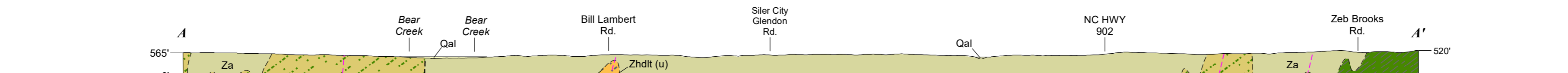
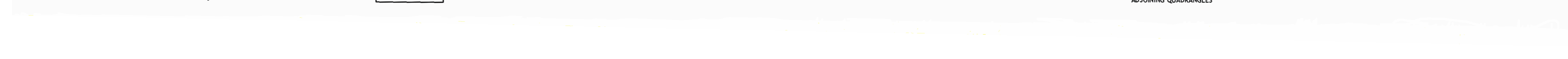
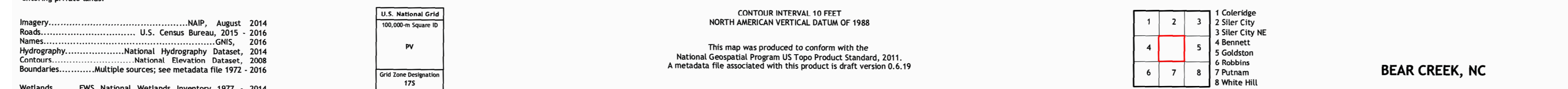
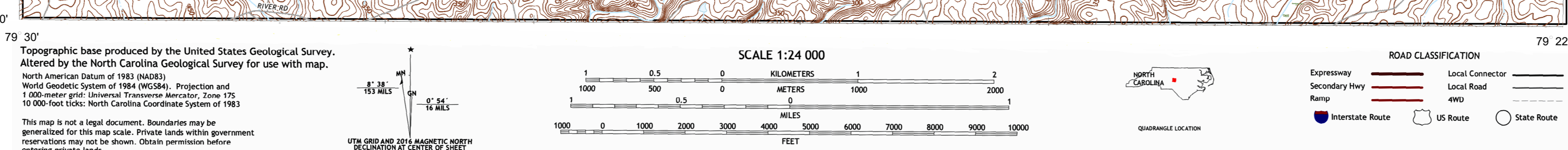
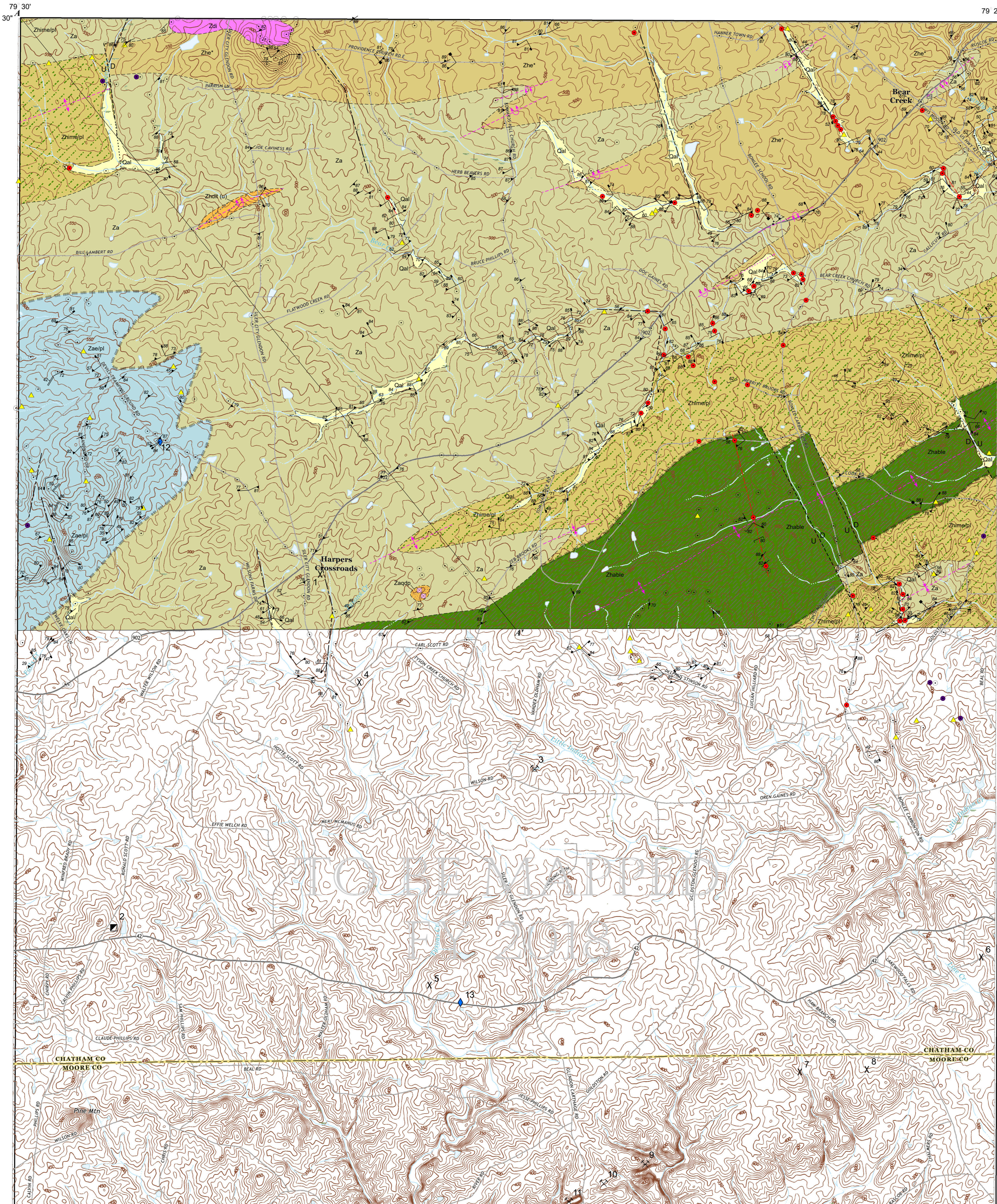
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**EXPLANATION OF MAP SYMBOLS**

**CONTACTS, FAULTS, AND OTHER FEATURES**

- inferred contact
- concealed contact
- gradational contact - inferred
- inferred brittle fault
- D indicates downthrown side, U indicates upthrown side
- quaternary alluvium contact
- linear geomorphic feature interpreted from hillshade LIDAR - origin uncertain
- inferred contact
- inferred gradational contact
- inferred fold hinge of anticline; dotted where concealed
- inferred fold hinge of syncline; dotted where concealed
- inferred fold hinge of overturned anticline
- inferred fold hinge of overturned syncline
- inferred diabase dike; dotted where concealed
- cross section
- inferred contact
- inferred fold axis

**PLANAR AND LINEAR FEATURES**

- 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 joint surface (multiple observations at one location)
- strike and dip of cleavage (multiple observations at one location)
- strike and dip of incision (multiple observations at one location)
- strike and dip of joint surface (multiple observations at one location)
- clast lineation
- strike and dip of inclined regional foliation
- strike and dip of inclined joint surface
- strike and dip of inclined regional foliation
- strike and dip of inclined joint surface

**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 NCGS, 1954); Not confirmed by NCGS
- 5 Barringer Phillips Prospect - copper (USGS, MRDS; Carpenter, 1976)
- 6 Glendon Pyrophyllite Mine - pyrophyllite (Reinemund, 1955); approximate location
- 7 Glendon Pyrophyllite Mine - pyrophyllite (Reinemund, 1955); approximate location
- 8 Currie Pyrophyllite Mine - pyrophyllite (Reinemund, 1955); approximate location
- mine shaft - abandoned
- 2 Bear Creek Mine - copper (USGS, MRDS; Carpenter, 1976; Nixon, 1954)
- quarry or mine - active
- 10 Standard Minerals (Wormlie) Pyrophyllite Mine - pyrophyllite
- quarry or mine - abandoned
- 3 Phillips Mine - copper (USGS, MRDS; Carpenter, 1976; Nixon, 1954)
- 9 White (Siler) Pyrophyllite Mine - pyrophyllite
- 11 Phillips Pyrophyllite Mine - pyrophyllite
- Geochronological sample location
- 12 Nd isotope analysis HOC262 (Samson et al., 1995)
- 13 Nd isotope analysis HOC262 (Samson et al., 1995)

**OTHER FEATURES**

- observation station location
- disabuse station location
- indicates location of quartz diolite porphyry boulders or outcrop
- indicates location of gabbroic boulders or outcrop
- indicates location of vuggy and/or massive quartz float

**REFERENCES:**

Abdelzahr, 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.

Altmendinger, 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.1. 43. 8p.

Bowman, J.D., 2010. The Aaron Formation: Evidence for a New Lithotectonic Unit in Carolina, 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. 139-161.

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 1:24,000, in color (Disseminated Open-File Report 2016-05).

Cardozo, N., and Altmendinger, R. W., 2013. Geophysical projections with GIS/Servernet: Computers and Geosciences, v. 51, no. 0, p. 193 - 205. doi: 10.1016/j.cageo.2012.07.021

Carpenter, P. Albert III., 1975 (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, 46 p.

Emmons, E., 1856. Geological Report of the Midland Counties of North Carolina. North Carolina Geological Survey, Miscellaneous Publication.

Fisher, R.V., and Schminse, R.-L., 1984. Pyroclastic rocks, Berlin, West Germany. Springer-Verlag, 472 p.

Glover, L., and Strick, A., 1973. The Virginia deformation, a late Precambrian to Early Cambrian (?) orogenic event in the central Piedmont of Virginia and North Carolina. American Journal of Science, Cooper v. 275A, pp. 234-251.

Green, G., 1977. The geology of the state belt rocks of the Goldston and Bear Creek quadrangles, North Carolina. Unpublished M.S. thesis, North Carolina State University, Raleigh, North Carolina, 68 p.

Green, G., Cavaroc, V., Stoddard, E., Abdelzahr, A., 1982. Volcanic and volcanoclastic facies in a part of the slate belt of the Carolina terrane. In: Beare, D., Black, W., Kist, S., Tull, J. (Eds.), Tectonic studies in the Ialalaga and Carolina state 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 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. Cross-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 Virginia deformation: implications of stratigraphic correlation in the Carolina slate belt. Carolina Geological Society field trip guidebook, 36 p.

Harris, C., and Glover, L., 1988. The regional extent of the ca. 600 Ma Virginia deformation: implications of stratigraphic correlation in the Carolina slate belt. Geological Society of America Bulletin, v. 100, pp. 202-217.

Hibbard, J.P., and Samson, S., 1998. Orogenesis exotic to the Iapetus 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. 191-209.

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, no. 2, pp. 299-320.

Hibbard, J.P., van Staal, C.R., Rankin, D.W., and Williams, H., 2006. Lithotectonic map of the Appalachian Orogen, Canada-U.S. Geological Survey of Canada, Geological Survey of Canada, Map 2006-01, 1:100,000-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, 165 p.

Klein, T.L., 1985. Glendon Pyrophyllite deposits - Steps 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 Maître, R.W., Ed., 2002. Igneous Rocks: A Classification and Glossary of Terms: Recommendations of the International Union of Geological Sciences (IUGS) Subcommittee 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 northwest Moore County, North Carolina. U.S. Geological Survey, Miscellaneous Field Studies, Map MF-190, scale 1:40,000.

McDaniel, R.D., 1976. Application of hot spring-fumarole alteration model to the genesis of the pyrophyllite deposits of the Carolina slate belt. Unpublished M.S. thesis, North Carolina State University, 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 Southern Crossroads area, southwestern Chatham County, North Carolina. Unpublished PhD dissertation, North Carolina State University, 164 p.

Olmsted, D., 1822. On the gold mines of North Carolina. American Journal of Science, v.5, 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, 164 p.

Pollock, J.C., Hibbard, J.P., and Sylvester, P.J., 2010. Depositional and tectonic setting of the Neoproterozoic-early Paleozoic rocks of the Virginia sequence and Albemarle Group, North Carolina. In: P.R. Bartholomew, J.J. Hibbard, J.P. and Karandina, P.M., eds. From Rodinia to Pangea: The Lithotectonic Record of the Appalachian Region: Geological Society of America Memoir 206, p. 738-772.

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 isotope 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 Zrcons. 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.

Stucky, J.L., 1929. Pyrophyllite deposits of North Carolina. North Carolina Department of Conservation and Development, Bulletin 37, 62 p.

Stucky, J.L., 1967. Pyrophyllite Deposits in North Carolina. North Carolina Geological Survey, Bulletin 80, scale 1:50,000.

Tadlock, K.A., and Lowey, S.L., 2006. Isotopic characterization of the Farrington pluton: constraining the Virginia orogeny. In Bradley, P.J., and Clark, T.W., editors, The Geology of the Chatham Hill, Hillsboro and Forest 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, K., 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.

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

By  
**Brandon T. Peach and Philip J. Bradley**

Geologic data collected in June 2017 through May 2018.

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