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DIVISION OF ENERGY, MINERAL, AND LAND RESOURCES
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NORTH CAROLINA GEOLOGICAL SURVEY
OPEN FILE REPORT 2014-01

QUATERNARY

- Qal — alluvium (Qal)
- Qt — terrace gravel deposits (Qt)

MESOZOIC

- Jd — diabase

Triassic Sedimentary Rocks

Deep River Basin: Durham and Sanford Sub-basins

- Trpc — conglomerate (Trpc) and interlayered sandstones, siltstones and mudstones of the Pekin Formation (Reinemund, 1955)

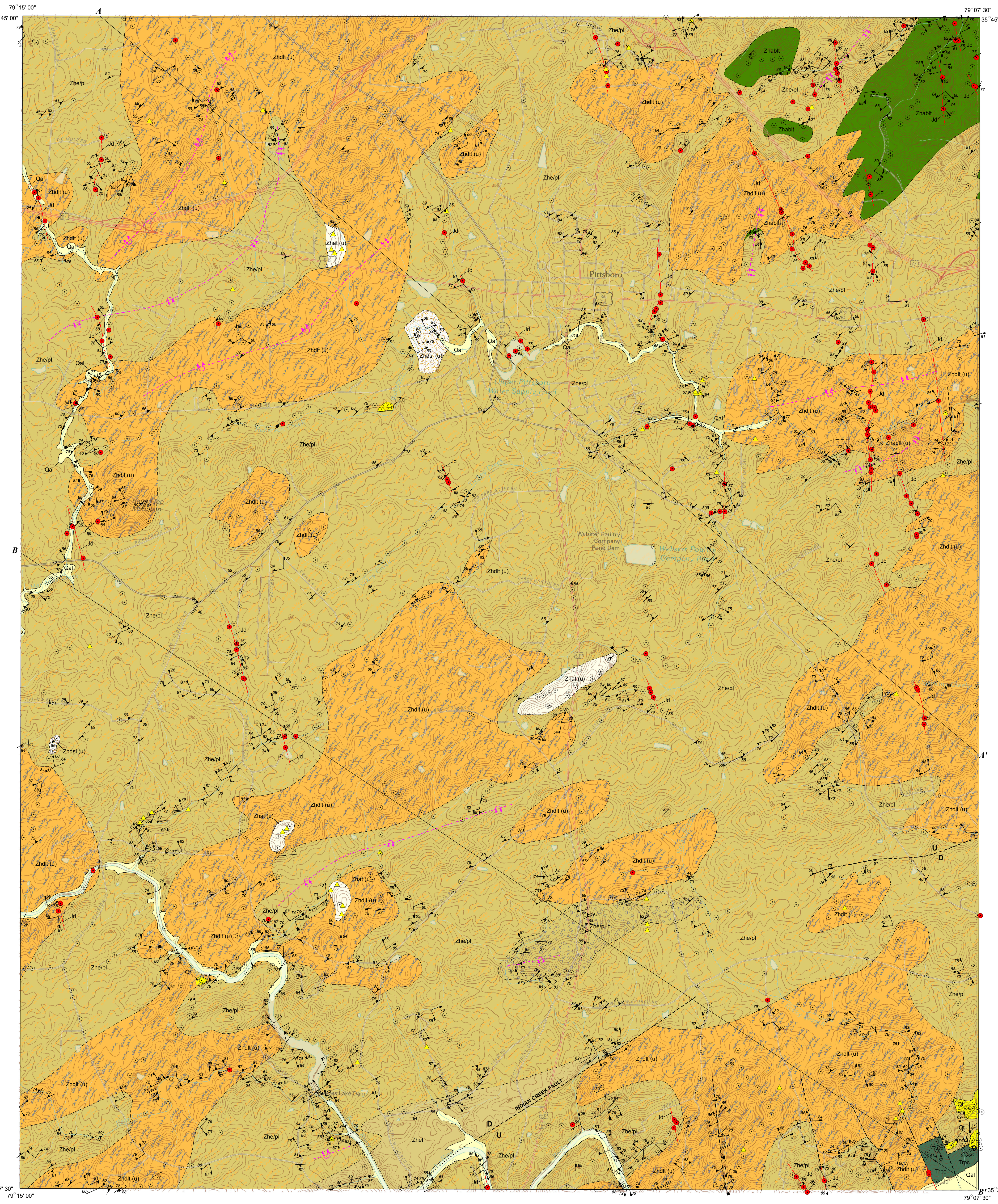
LATE PROTEROZOIC

Metamorphic Rocks

Hyco Formation

metamorphosed volcaniclastic sedimentary and pyroclastic rocks associated with Hyco Formation: upper portion (stratigraphic relations uncertain) ca. 612 - 616 Ma (Wortman et al., 2000; Bowman, 2010; Bradley and Miller, 2011)

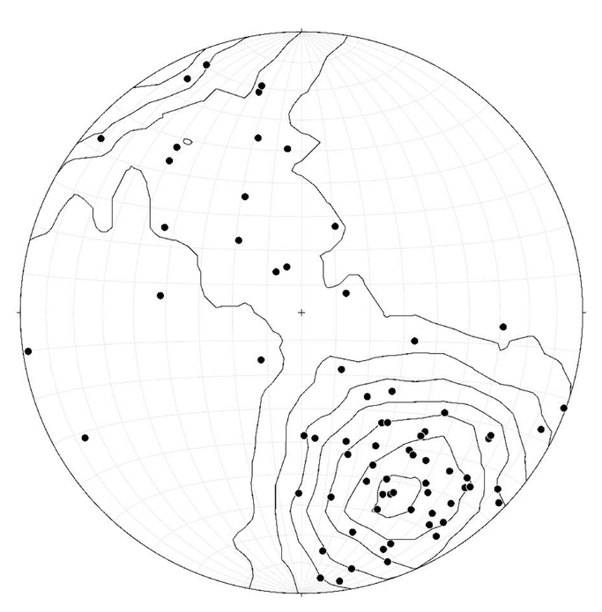
Zq, Zhat (u), Zhel, Zhadlt (u), Zhe/pl, Zhdlt (u), Zhe/pl-c, Zhablt, Zhdsi (u)



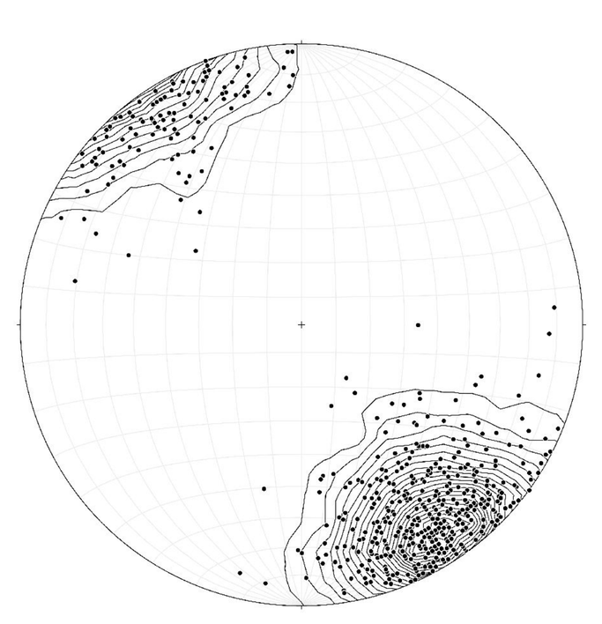
Geology mapped between August 2011 through July 2012 and February through May 2014.
This map supersedes NCGS OFR 2012-03.

Equal Area Schmidt Net Projections and Rose Diagram

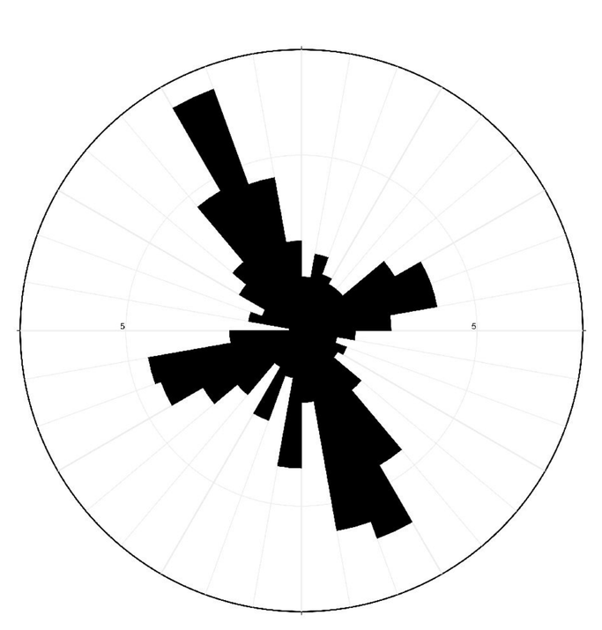
Plots and calculations created using Stereonet v. 8.6.0 based on Allmendinger et al. (2013) and Cardozo and Allmendinger (2013)



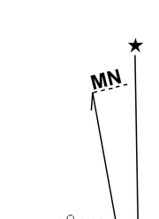
Equal Area Schmidt Net Projection of
Contoured Poles Primary Bedding and Layering
Contour Interval = 2 sigma N = 73



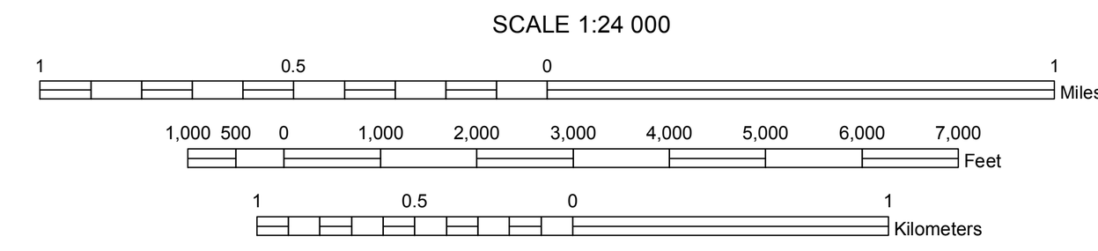
Equal Area Schmidt Net Projection of
Contoured Poles to Foliation and Cleavage
Contour Interval = 2 sigma N = 535



Unidirectional Rose Diagram of Joints N = 588
Outer Circle = 8%
Mean vector = 219 degrees

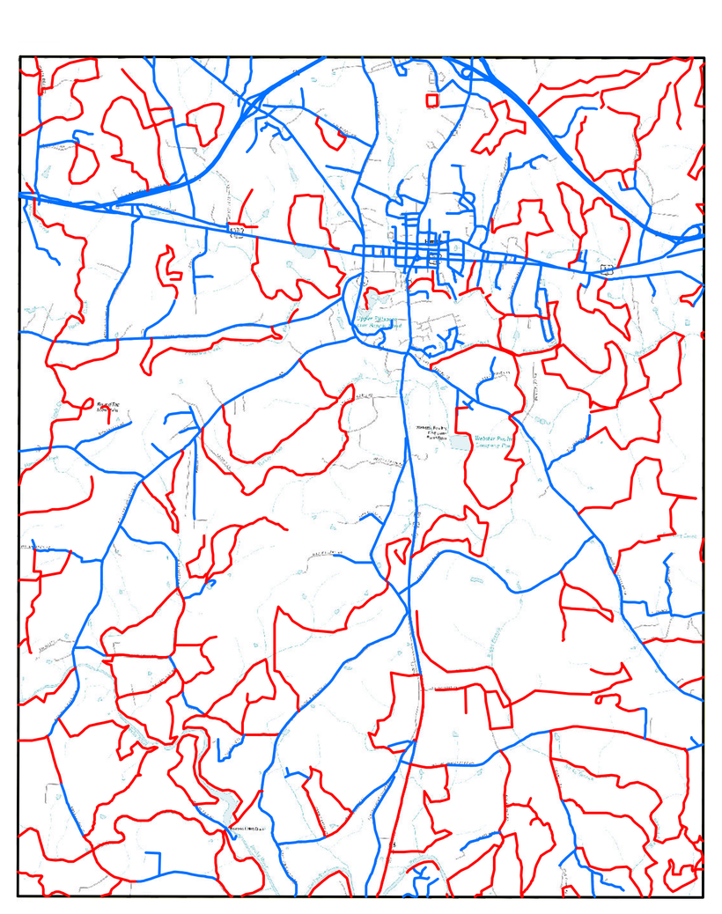


2010 Magnetic North Declination
at Center of Sheet =
8 degrees 29 minutes West



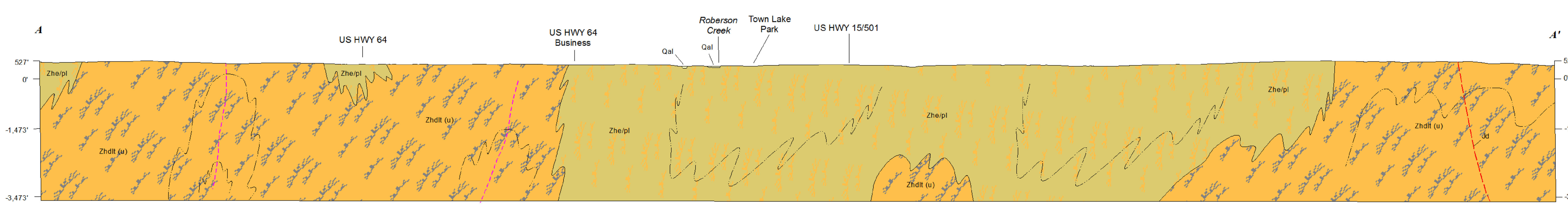
CONTOUR INTERVAL - 10 FEET

MAP LOCATION

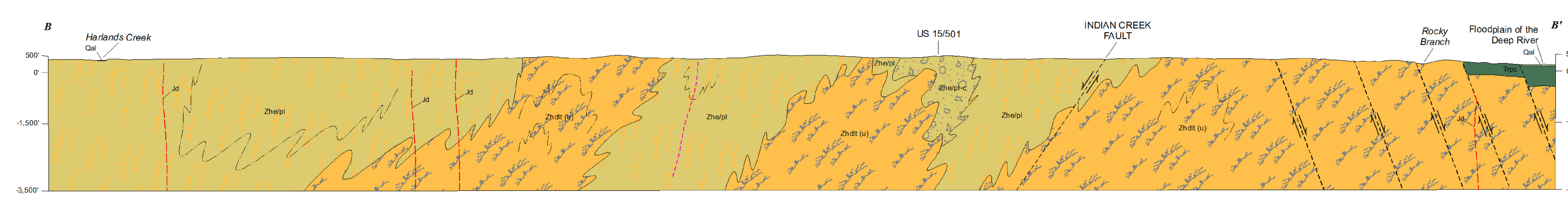


TRAVERSE MAP

- by foot
- by car



cross section scale - 1:24 000 no vertical exaggeration



DESCRIPTION OF MAP UNITS

Pre-Mesozoic crystalline rocks in the Pittsboro Quadrangle are part of the redefined Hyco Arc (Hibbard et al., 2013) within the Neoproterozoic to Cambrian Carolina terrane of the Carolina Zone (Hibbard et al., 2002; 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; Pollock, 2007, respectively).

The Hyco Arc and Virgilina sequence 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; Hibbard and Samson, 1995). In the map area, original layering of Hyco Formation lithologies are interpreted to range from shallowly to steeply dipping due to open to isoclinal folds that are locally overturned to the southeast.

Map units of meta-volcaniclastic 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 and tuffs unit is interpreted to represent eruption of intermediate to mafic lava flows and associated pyroclastic deposits. The epiclastic/pyroclastic units are interpreted to represent deposition from the erosion of dormant and active volcanic highlands. Some of the meta-volcaniclastic units within the map area display lithologic relationships similar to dated units present in northern Orange and Durham Counties. Due to these similarities, the meta-volcaniclastic 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 eastern portion of Chatham County is underlain by Triassic-aged sedimentary rocks of the Deep River Mesozoic basin which is separated into three sub-basins (Durham, Sanford and Wadesboro). The Colon cross-structure (Reinemund, 1955), located immediate southeast of the Pittsboro Quadrangle, is a constriction zone in the basin characterized by crystalline rocks overprinted by complex brittle faulting. The Colon cross-structure marks the transition between the Durham and Sanford sub-basins. A small portion of the southeast corner of the Pittsboro Quadrangle is underlain by rocks associated with the Pekin Formation of the Sanford sub-basin. Dikes of Jurassic aged diabase intrude the Triassic sediments. Diabase dikes also intrude the crystalline rocks of the map area. Quaternary aged 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 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.

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. Past workers within the adjacent areas (Eligman, 1987 and Wagener, 1964 and 1965) have used various nomenclature systems for the igneous rocks. The raw data, when available, of these earlier workers was recalculated and plotted on ternary diagrams and classified based on IUGS nomenclature. 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 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.

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.

Trpc — **Trpc – Conglomerate of the Pekin Formation:** Reddish-brown to dark brown to purplish-red, irregularly bedded, poorly sorted, cobble to boulder conglomerate. Clasts are chiefly miscellaneous felsic and intermediate metavolcanic rocks and quartz. Typically present adjacent to border faults. Identified as the Pekin Formation-basal conglomerate by Reinemund (1955).

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. 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.

METAVOLCANIC UNITS

Hyco Formation – Upper Portion

Zq — **Zq – Quartz body:** White, beige, red, and tan; sugary to porcelaneous; very fine- to medium-grained massive quartz rock to quartzite-like rock. Outcrops are usually massive. May contain vugs with crystal shaped terminations. Map areas contain boulders (up to several feet in diameter) and/or outcrops of white colored massive quartz.

Zhat (u) — **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.

Zhel — **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.

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. Contains lesser amounts of fine- to coarse tuff and lapilli tuff with a cryptocrystalline-like groundmass. 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.

Zhe/pl-c — **Zhe/pl-c – Conglomerate dominated mixed epiclastic-pyroclastic rocks:** Grayish-green to greenish-gray, metamorphosed, conglomerate and conglomeratic sandstone. Contains abundant subangular to angular clasts of dacite in a strongly tuffaceous (with a cryptocrystalline-like groundmass) clastic matrix. Interpreted as a resedimented hyaloclastite body likely sourced from a nearby dacite dome.

Zhdlt (u) — **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 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. The unit occurs as map scale pods surrounded by clastic rocks of Zhe/pl unit. 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.

Zhdsi (u) — **Zhdsi (u) – Dacitic shallow intrusive of the upper portion of the Hyco Formation:** Gray-green, light green to green, greenish-gray to light gray; dacite, plagioclase porphyritic dacite with a granular-textured groundmass to micro-granodiorite (intrusive texture visible with 7x hand lens). Locally fine- to medium grained granodiorite present. Plagioclase phenocrysts , when present, range from less than 1 mm to 4 mm. Black colored amphibole, when visible, occurs as phenocrysts (less than 1 mm to 1 mm) and as intergrowths with plagioclase. Amphibole intergrowths distinguish rock from fine-grained tuffs. Interpreted as shallowly emplaced dacite probably co-magmatic with Zdlt (u) unit.

Zhadlt (u) — **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. Interlayed 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 — **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 meta-sediments identical to the Zhe/pl unit.

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CONTACTS, FOLDS AND OTHER FEATURES

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

- contact - location inferred
- contact - location concealed
- Qal contact
- brittle fault - inferred
- brittle fault - concealed
- fold axis - overturned anticline - inferred
- fold axis - overturned syncline - inferred
- inferred diabase dike; dotted where concealed
- in cross section, fold form lines
- in cross section, inferred axial trace of large-scale fold
- A — A' cross section line
- strike and dip of inclined primary bedding and layering
- strike and dip of inclined primary bedding and layering (multiple observations at one locality)
- strike and dip of inclined overturned primary bedding
- strike and dip of inclined overturned primary bedding (multiple observations at one locality)
- strike and dip of primary flow banding
- 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 locality)
- strike of vertical regional foliation (multiple observations at one locality)
- strike and dip of cleavage
- strike and dip of cleavage (multiple observations at one locality)
- diabase station location
- station location with conspicuous amounts of quartz cobbles and/or boulders
- Strike and dip of inclined mylonitic foliation
- Strike and dip of inclined mylonitic foliation (multiple observations at one locality)
- Fault plane - normal
- strike and dip of inclined joint surface
- strike and dip of inclined joint surface (multiple observations at one locality)
- strike of vertical joint surface
- strike of vertical joint surface (multiple observations at one locality)
- bearing and plunge of aligned clast lineation
- bearing and plunge of crenulation lineation
- bearing and plunge of mineral lineation
- bearing and plunge of slickenline
- station location
- active quarry - crushed stone (3M pit)

Base map is from USGS 2010 GeoPDF of the Pittsboro 7.5-minute quadrangle.
Aerial 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).

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

GEOLOGIC MAP OF THE PITTSBORO 7.5-MINUTE QUADRANGLE, CHATHAM COUNTY, NORTH CAROLINA

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

Digital representation by Michael A. Medina and Philip J. Bradley

2014