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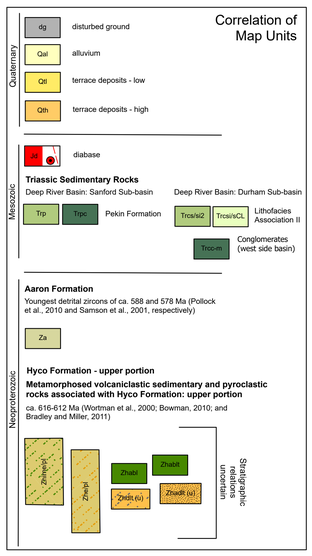
Correlation of Map Units



INTRODUCTION

The Merry Oaks 7.5-minute Quadrangle lies in the east central-portion of the North Carolina Piedmont. The quadrangle includes the unincorporated crossroads of Merry Oaks, Griffins Crossroads and Wilsonville. Two transportation corridors, US HWY 64 and 1 are present in the quadrangle. US HWY 64 cuts across the northern portion of the quadrangle while US HWY 1 cuts diagonally across the map in the southeast portion of the quadrangle.

B. Everett Jordan Lake, an US Army Corps of Engineers administered reservoir, occupies a large portion of the quadrangle. The construction of the B. Everett Jordan Lake Dam in 1974, impounded the Haw and New Hope Rivers, resulting in today's Jordan Lake (5640 ha). After several years of flooding, the current mean water level of 216 feet (66 m) above sea level in the reservoir was reached in 1983. The record level of Jordan Lake thus far is 233.8 ft (71 m) in 2003. The New Hope River is completely inundated by the lake in the Merry Oaks Quadrangle. A small segment of the Deep River is present in the southwest corner of the quadrangle. The Deep and Haw Rivers join to form the Cape Fear River to the south in the adjoining Moncure Quadrangle . The smaller tributaries of Roberson Creek, Windfall Branch, Stinking Creek and Weaver Creek flow into Jordan Lake. Shaddox Creek flows directly to the Cape Fear River. Natural exposures of crystalline and Triassic rocks, as well as younger Quaternary sediments, occur along these named and other unnamed creeks. Rock exposure at road cuts, ridges, resistant finned-shaped outcrops and pavement outcrops locally occur outside of drainages. Abundant exposures of bedrock, primarily Triassic in age, are found along the shores of Jordan Lake; they are easily accessible at normal pool and low water levels. The elevations in the map area range from approximately 510 feet above sea level near the northwest corner of the quadrangle to approximately 160 feet along the Haw River as it flows toward the southern edge of the quadrangle.

Geologic Background

In the western portion of the Merry Oaks Quadrangle, the crystalline rocks are part of the redefined Hyco Arc and Aaron Formation (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. 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.

The eastern portion of the quadrangle 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 (Campbell and Kimball, 1923 and Reinemund, 1955), partially located within the 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. The Merry Oaks Quadrangle contains the Triassic-aged unit of the Pekin Formation of the Sanford sub-basin and the Lithofacies Association units of the Durham sub-basin. Detailed descriptions of the Triassic sediments in the Sanford sub-basin are provided in Reinemund (1955). A detailed comparison of the Durham and Sanford sub-basins is provided in Clark et al. (2001). Dikes of Jurassic aged diabase intrude the Triassic sediments and crystalline rocks of the map area. Quaternary aged alluvium is present in most modern river valleys, with at least two levels of fluvial terraces along the major drainages. These terraces, where preserved, likely mark the location and elevation of ancestral river systems, prior to incision to the modern floodplain levels.

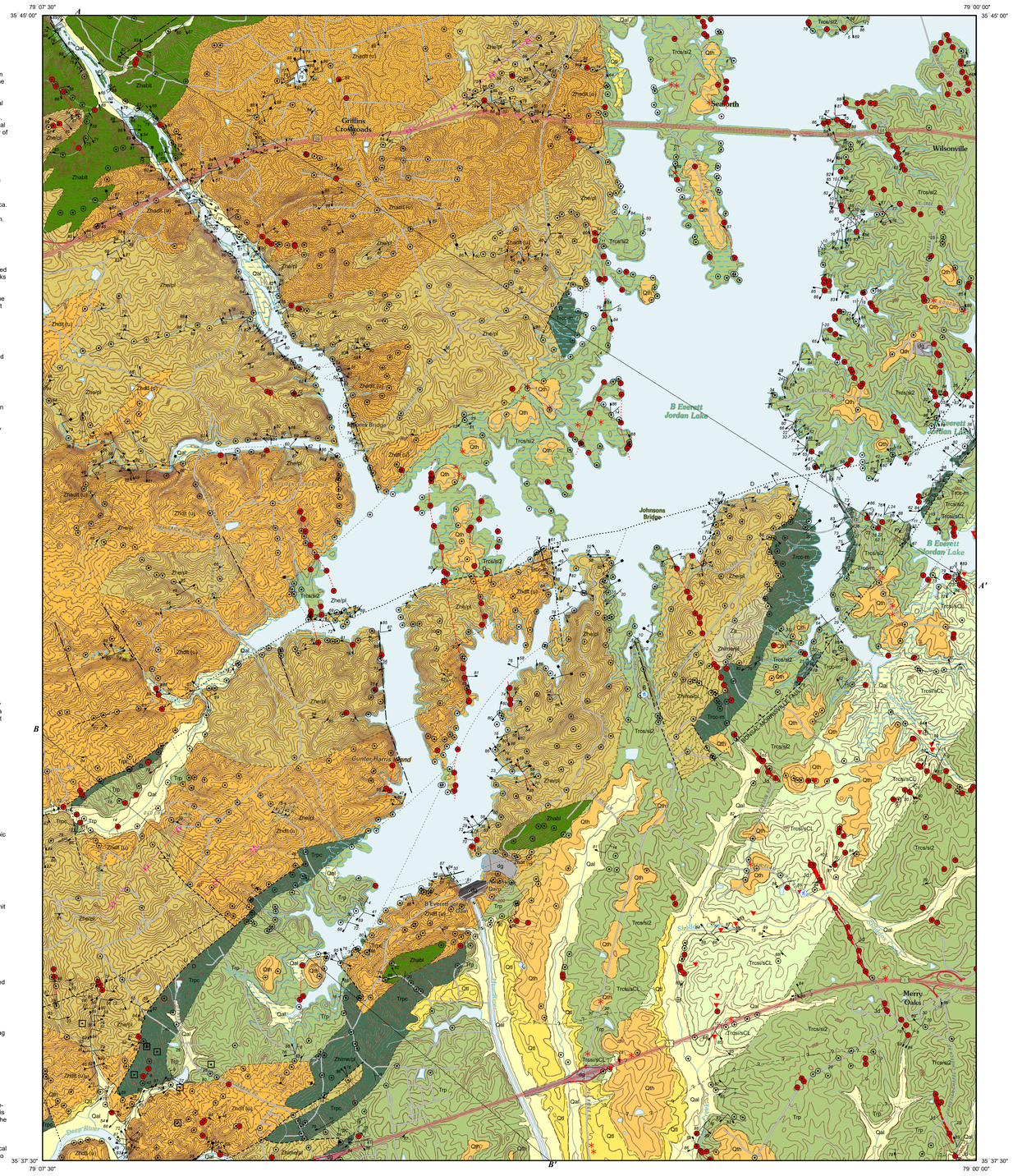
Folds

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.

Faults

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 area. The quadrangle includes the eastern portion of the Colon cross-structure that marks the transition between the Durham and Sanford sub-basins. The brittle faulting and lineaments are interpreted to be associated with Mesozoic extension.

A fault bounded block within the Carolina terrane (in the northwest corner of the Moncure Quadrangle and southwest corner of the Merry Oaks Quadrangle) has been identified with rotated metamorphic foliations up to 70 degrees clockwise. This rotation is speculated to be related to rotation of a breached relay ramp.



Previous Mapping – Sanford and Durham sub-basins in the Deep River basin

The Merry Oaks Quadrangle is situated in the transition between the Durham and Sanford sub-basins. In the Sanford sub-basin, a three-layer stratigraphy has been identified and formalized from oldest to youngest as the Pekin, Cumnock and Sanford Formations (Campbell and Kimball, 1923 and Reinemund, 1955). In the Durham sub-basin, this three-layer system is not recognized. Bain and Harvey (1977) separated the Durham sub-basin into several map facies; later, North Carolina Geological Survey staff separated the Durham sub-basin into lithofacies associations using the nomenclature of Smoot et al. (1988). Hoffman and Gallagher (1989) began using the lithofacies association nomenclature and it was subsequently adopted for all mapping in the Durham sub-basin. The formation mapping of Reinemund (1955) in the Sanford sub-basin and the lithofacies association mapping in the Durham sub-basin are incompatible (Clark et al., 2001). These two methods of mapping meet in the Merry Oaks Quadrangle. The detailed investigation of the contrasting mapping methods and establishment of a unified stratigraphic nomenclature for the Sanford and Durham sub-basins is out of the scope of this mapping project. As such, the Pekin Formation was extended into the southern portion of the Merry Oaks Quadrangle, as originally mapped by Reinemund (1955), terminating in a queried geologic contact that marks the change of unit nomenclature from the Sanford sub-basin to the Durham sub-basin. Additional work is needed to establish a new stratigraphic nomenclature for the entire Deep River basin.

Mineral Resources

Clay Products and Crushed Stone

The red claystones of the Deep River basin continue to supply area brick manufactures raw material. In the 1950's, it was reported that multiple brick and tile producers were active in the nearby area (Reinemund, 1955). It has been and continues to be an important location for clay products.

One active brick plant is in operation in the quadrangle adjacent to US HWY 1. The clay pits that supply the plant are located in the adjacent New Hill and Moncure quadrangles. Two abandoned crushed stone quarries are present; one in the southwest corner of the map and the other near the northwest corner of the map.

Quaternary Deposits

Quaternary deposits in the southernmost part of the Merry Oaks Quadrangle were previously mapped by Reinemund (1955), along with bedrock mapping; however, the mapping was conducted prior to 1:24,000 topographic map availability. The Quaternary mapping for this project utilized digital county soil survey parent material maps (Soil Survey Staff, 2019), high resolution LiDAR surface topography, data from Reinemund (1955), and new field observations (outcrops and hand augers). The Quaternary fluvial sediments are here divided into 3 map units (modern floodplain and two terrace levels). Three terrace levels had been previously mapped by Reinemund (1955). However, based on LiDAR and soil survey mapping, as well as practical considerations, we chose to map only two terrace levels (Qth and Qtl). This model is similar in concept to terrace mapping in 1:24,000 quadrangles to the southwest (Bradley et al., 2020; Rice et al., 2020).

The oldest and highest terrace deposits (Qth) contains fluvial deposits in an ancestral Haw River and New Hope River system that has since incised to its present level. The elevation of this terrace level in the Merry Oaks Quadrangle typically ranges from as 200 feet to 280 feet asl, about 30 to 90 feet above the modern (or preexisting) floodplain of the Haw and New Hope Rivers. One area, in the southwest part of the quadrangle, contains a lag of rounded quartz gravels at elevations above 300 feet asl. There are likely multiple terrace levels within this map unit that we chose to not differentiate because of the high degree of dissection and the fragmentary record. Possible causes for the river's overall incision during the Quaternary include tectonic, glacial isostatic adjustment (forebulge of Laurentide Ice Sheet) and climatic processes. The age of deposits within the high terrace unit are speculatively middle Pleistocene based on the terrace height above the modern floodplain (Mills, 2000), degree of dissection, and weathering characteristics (Suther et al., 2011). Deposits in the high terrace are notably thinner (not more than a few feet thick) and finer-grained (less gravelly) than in high terraces along the Deep River and Cape Fear River valleys to the south and west. A thin gravel lag may be found at the base of the unit, but it is otherwise generally a silt loam, clay loam, sandy loam or fine sand in texture. It appears to represent a strath terrace over Triassic residuum, which is typically reddish-brown silty clay to silty clay loam. Deposits of Qth are only mapped where thicker than about 1.5 feet (0.5 m). Although a thin layer of loamy to fine sandy deposits occur in many areas, they are considered too thin to be of significance and some could be of pedogenic origin (Griffin and Buol, 1988).

Low terrace deposits (Qtl) contain younger Cape Fear River Basin fluvial deposits, with terrace elevations ranging from 180 feet to 220 feet asl, typically about 10 to 30 feet above the local modern floodplain. The age of deposits within the low terrace unit are speculatively late Pleistocene to early Holocene based on the terrace height above the modern floodplain (Mills, 2000; Suther et al., 2011). Deposits of the low terrace are generally fine-grained and can be several feet thick. Many former areas of low terrace are likely now submerged by Jordan Lake.

Alluvial deposits on the modern (Holocene) floodplain (Qal) consist mainly of silt loam to silty clay loam in modern river valleys within in the Triassic Basin. Fine to medium sand occurs in points bars and river channels, along smaller creeks in crystalline terrain (where it can be gravelly) and likely at depth from reworking of Pleistocene and older sediments. Along the Haw and New Hope River valleys, in the area which contains the terraces (Triassic Basin), the modern floodplain ranges in elevation from about 170 feet asl (Haw River valley on southern edge of quadrangle) to about 190 feet asl (buried New Hope River Valley). The Haw River valley rises to 290 feet asl in the northwestern part of the Merry Oaks Quadrangle; however, terraces deposits are not found in this terrain.

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 and Triassic sediments of the map area. Triassic-aged sediments and 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).

Crystalline rock unit descriptions common to Bradley et al. (2021) and Bradley et al. (2014) from the Moncure and Pittsboro 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 rocks. 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

dg **dg - Disturbed ground:** consists of fill or removed earth in B. Everett Jordan Lake Dam and fill in highway embankments for interchanges and bridge crossings (Route 1).

Qal **Qal - Modern (Holocene) floodplain deposits:** silt loam to silty clay loam, with fine to medium sand deposits in point bars and channels deposits; smaller tributaries in the Carolina terrane can have more sandy or gravelly alluvium ; brown to reddish brown to grayish brown; soft; crudely stratified; can be several feet thick or more, but maximum thickness is unknown. May include very low terraces that are periodically inundated by modern floods. Contains weak to moderately developed soil profiles. Structural measurements depicted on the map within Qal represent outcrops of crystalline rock inliers surrounded by alluvium.

Qtl **Qtl – Quaternary low terrace deposits:** fine sand to loam to silty clay loam; gravel generally not present, but may contain a thin lag of quartz gravel near unit base; yellowish brown to strong brown to dark grayish brown; in some areas is difficult to differentiate from high levels of modern floodplain; ranges from 2 feet to more than 10 feet thick

Qth **Qth – Quaternary high terrace deposits:** silt loam to clay loam to loamy fine sand; rare rounded quartz gravel, but may contain a thin lag of gravel near unit base; yellowish brown to brown; gravel is rare in central and northern parts of the quadrangle, but may occur as a lag at the basal contact with underlying residuum; total thickness of Qth map unit in this quadrangle is typically 1.5 to 5 feet; this unit generally consists of a lag deposit in strath terraces over a reddish brown, silty clay to clay residuum developed into fine-grained Triassic bedrock. Mapped areas may include multiple, undifferentiated high terrace levels.

Intrusive Unit

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.

Triassic Sediments of the Deep River Basin Chatham Group

Trcs/sCL **Trcs/sCL - Siltstone with interbedded sandstone of Lithofacies Association II with chert and limestone:** reddish-brown, extensively bioturbated, muscovite-bearing, siltstone interbedded with tan to brown, fine- to medium-grained, muscovite-bearing, arkosic sandstone, usually less than one meter thick. Siltstones can contain abundant, bedded, calcareous concretions (interpreted as caliche) and iron nodules. Bioturbation is usually surrounded by greenish-blue to gray reduction halos. Local occurrence of chert and less common limey sediments and nodular and thin limestones. Unit contacts are based on Bain and Harvey (1977) and the identification of chert debris in the field. Portions of unit may correlate with the Cumnock and Pekin Formations.

Trcs/sl2 **Trcs/sl2 - Sandstone with interbedded siltstone of the Chatham Group Lithofacies Association II:** Grayish-pink to pale-red, micaceous (typically white mica), coarse- to very coarse-grained, pebbly, cross-bedded lithic arkose interbedded with maroon, micaceous mudstone, burrowed and rooted siltstone. Bioturbation is usually surrounded by greenish-blue to gray reduction halos. Good outcrops typically exhibit cyclical fining upward depositional sequences. These rocks are assigned to the Lithofacies Association II of Hoffman and Gallagher (1989) and Watson (1998). This unit has been extended into the Merry Oaks Quadrangle to edge-match with the Farrington Quadrangle geologic map (Bradley et al., 2007) and the Raleigh 100K geologic map (Clark et al., 2004) .The clastic rocks of Lithofacies Association II are interpreted to have been deposited in a meandering stream fluvial system.

Trcc-m **Trcc-m - Conglomerate of the Merry Oaks Quadrangle:** Reddish-brown to dark brown, 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. May correlate with the conglomerates of the Pekin Formation.

Trp **Trp – Pekin Formation:** Gray, Brown to maroon, white mica bearing, interbedded mudstones, siltstones arkosic sandstones and locally conglomerates. Outcrops and boulders of float identified as part of Pekin Formation are strongly indurated compared to sediments identified as part of the Durham sub-basin. Identified as the Pekin Formation by Reinemund (1955).

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. Outcrops and boulders of float identified as part of Pekin Formation are strongly indurated compared to conglomerates identified as part of Durham sub-basin. Identified as the Pekin Formation-basal conglomerate by Reinemund (1955).

Metavolcanic and Metavolcaniclastic Units

Aaron Formation

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.

Hyco Formation – Upper Portion

Zhi/mp/pl **Zhi/mp/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 Zhabl and Zhabit 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.

Zhabl **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 float boulders. Conglomeratic rocks consisting of angular clasts of andesite and/or basalt occur locally and are interpreted as resedimented hyaloclastite.

Zhabll **Zhabll – 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 meta-sediments identical to the Zhe/pl and Zhime/pl units.

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. 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.

Zhadlt (u) **Zhdlt (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.

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.

EXPLANATION OF MAP SYMBOLS

CONTACTS, FAULTS, AND OTHER FEATURES

- inferred contact, dotted where concealed
- inferred diabase, dotted where concealed
- inferred diabase intruded along fault, dotted where concealed
- surficial units contact
- lineament - lidar inferred
- inferred contact, identity or existence questionable
- inferred brittle fault, dotted where concealed
- Bonsal-Morrisville fault, dotted where concealed; ball and bar on downthrown block
- overturned fold axis - inferred (anticline)
- overturned fold axis - inferred (syncline)
- A — A' cross section line

IN CROSS SECTION

- contact
- brittle fault
- diabase
- inferred fold axis
- fold form lines

PLANAR AND LINEAR FEATURES

- strike and dip of bedding or layering
- strike and dip of bedding or layering (multiple observations at one location)
- strike of vertical bedding or layering
- strike and dip of Triassic bedding (from USGS PP 246)
- horizontal Triassic bedding (from USGS PP 246)
- strike and dip of foliation
- strike and dip of foliation (multiple observations at one location)
- strike of vertical foliation (multiple observations at one location)
- strike and dip of cleavage
- strike and dip of cleavage (multiple observations at one location)
- strike and dip of cataclastic cleavage
- strike and dip of cataclastic cleavage (multiple observations at one location)
- fault plane
- strike and dip of inclined joint
- strike and dip of inclined joint surface (multiple observations at one location)
- strike of vertical joint
- strike of vertical joint surface (multiple observations at one location)
- strike and dip of welding/compaction foliation
- slickenside (multiple observations at one location)
- quartz vein
- quartz vein (multiple observations at one location)
- slickenline

QUARRIES AND OTHER FEATURES

- observation station location
- diabase station location
- location of chert debris
- quarry - crushed stone, abandoned
- Core material in the NCGS collection (CH-C-01-89 to CH-C-07-89)
- CGS 1977 field trip stop
- Hand auger or surficial geology exposure: Grimley

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Altered by the North Carolina Geological Survey for this map
Produced by the United States Geological Survey
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, July 2008
Roads.....©2006-2010 Tele Atlas
Names.....GNIS, 2008
Hydrography.....National Hydrography Dataset, 2008
Contours.....National Elevation Dataset, 2008

MN 8° 34' 152 MILS | GN | 1° 8' 20 MILS
UTM GRID AND 2010 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

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