North Carolina Department of Environmental Quality
Division of Energy, Mineral and Land Resources
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North Carolina Geological Survey
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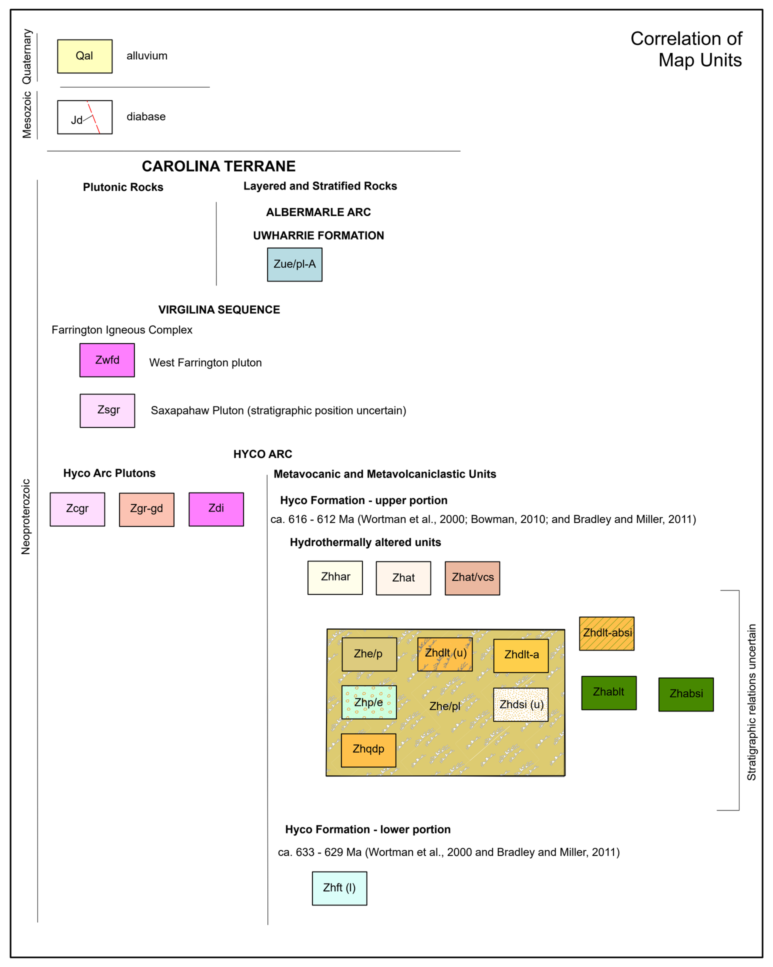
Correlation of Map Units



INTRODUCTION

The Saxapahaw 7.5-minute Quadrangle lies in the east-central portion of the North Carolina Piedmont. The Haw River bisects the quadrangle from the northwest corner to the southeast corner of the quadrangle; the Alamance – Orange County line crosses the eastern portion of the quadrangle from north to south. The county line follows the Haw River in the southeast of the quadrangle. The northeastern portion of the quadrangle is crossed by the northwest-southeast trending NC Highway 54. NC Highway 87 crosses the southwestern portion of the quadrangle.

The quadrangle drains to the Haw River along two tributaries of the same name - Cane Creek (one on the west side of the Haw and the other on the east side of the Haw), Marys Creek, Varnals Creek, Meadow Creek, Motes Creek and other named and unnamed creeks. Natural exposures of crystalline rocks occur mainly along these and numerous unnamed creeks. Rock exposure at road cuts, ridges, resistant finned-shaped outcrops and pavement outcrops occur locally outside of drainages. The elevations in the map area range from above 770 feet above sea level on a ridge near the northeast corner of the map southwest of HWY 54 (underlain by the resistant Zhdlt unit); to less than 390 feet along the Haw River near the southeastern corner of the quadrangle.

Geologic Background and Past Work

Pre-Mesozoic crystalline rocks in the Saxapahaw Quadrangle are part of the redefined Hyco Arc (Hibbard et al., 2013) within the Neoproterozoic to Cambrian Carolina terrane (Hibbard et al., 2002; and Hibbard et al., 2006). In the region of the map area, the Carolina terrane can be separated into two lithotectonic units: 1) the Hyco Arc and 2) the Aaron Formation of the redefined Virgilina sequence (Hibbard et al., 2013). The Hyco Arc consists of the Hyco Formation which includes 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) portions with an apparent intervening hiatus of magmatism. In northeastern Chatham County, Hyco Formation units are intruded by the East Farrington pluton and associated West Farrington pluton. Two age dates are available for the East Farrington Pluton: a recent date of 569.0 ± 1.1 Ma from Goliber (2020) and a previous date of ca. 579 Ma from Tadlock and Loewy (2006). The Aaron Formation consists of metamorphosed layered volcaniclastic rocks with youngest detrital zircons of ca. 578 and 588 Ma (Samson et al., 2001 and Pollock, 2010, respectively).

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 is interpreted to range from shallowly to steeply dipping due to open to tight folds that are locally overturned to the southeast.

Map units of metavolcanic and metavolcaniclastic rocks include various lithologies that when grouped together are interpreted to indicate general environments of deposition. The dacitic lavas and tuffs unit 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).

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, 1955), located approximately 18 miles to the southeast 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. This complex brittle faulting is likely present in the quadrangle. Dikes of Jurassic aged diabase intrude the crystalline rocks of the map area. Quaternary-aged alluvium is present in most major drainages.

Mineral Resources

There are no active mining activities currently in the quadrangle. Schmidt et al. (2006) identified the Mazejka Gold Prospect (1 shaft) and unnamed "gold prospect pits" in the southwestern portions of the quadrangle. The USGS Mineral Resources Data System (MRDS) identified the Allen Prospect for pyrophyllite in the southwestern portion of the quadrangle.

Parts of the southern portion of the quadrangle were mapped at reconnaissance-scale and satellite remote sensing as part of the Schmidt et al. (2006) study. The area was identified as containing large zones of high-sulfidation alteration with the potential for pyrophyllite and gold resources. The abandoned Snow Camp Mine for pyrophyllite is located in the adjacent quadrangle to the southwest.

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. Jurassic diabase dikes are unmetamorphosed.

A preliminary review of the area geology is provided in Bradley (2013). Unit descriptions common to Bradley et al. (2022) and Bradley et al. (2008) in the Silk Hope and White Cross geologic maps, respectively, were used for consistency 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 the classification and naming of the units. The classification and naming of the rocks are 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.

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 spheroidally weathered boulders with a grayish-brown weathering rind. Red station location indicates outcrop or boulders of diabase.

Zsgr

Zsgr - Granite to granodiorite of the Saxapahaw pluton: Mainly, leucocratic, medium-grained hypidomorphic granular, granite to granodiorite. Quartz grains are conspicuous and weather in positive relief. Mafic minerals are composed of aggregates of chlorite and epidote (likely from the alteration of biotite). In the northwest portion of the quadrangle, there are several satellite plutons interpreted to be related to the Saxapahaw pluton; they are texturally similar but fine- to medium-grained. Schmidt et al. (2006) interpreted the pluton as being noticeably silicified. Schmidt et al. (2006) reported several whole rock and point count analyses with interpreted rock types included granite, porphyritic granite, granite porphyry, porphyritic granodiorite and quartz monzonite. Based on map pattern and intrusive relationships (high angle truncation of Hyco Formation units), the Saxapahaw pluton may be related to the Farrington pluton family or Albemarle Arc plutonism. Ingle (2003) reported a discordant age from the pluton with an upper intercept of 605 +-7.4 Ma.

Zwfd

Zwfd – West Farrington pluton diorite: White to cream-colored, unfoliated, medium- to coarse-grained, with dark green amphibole (actinolite after hornblende) diorite. Locally with chlorite/biotite; dominantly equigranular but locally weakly plagioclase porphyritic; includes quartz diorite, granodiorite, quartz monzodiorite, and tonalite; commonly contains ovoid enclaves of green to black microdiorite to 0.5 m; grades to local patches of more mafic diorite and gabbro; fine dense to slabby hornfelsed country rocks occur locally as enclaves and near contacts; locally strongly saussuritized and pale greenish; white weathering with plagioclase occurring in positive relief giving "bumpy" texture.

Zcgr

Zcgr - Granite of the Chatham pluton: Leucocratic, light brownish to beige or creamy, and locally pale pink or green; medium- to coarse-grained, equigranular metamorphosed leucocratic granodiorite and granite; locally weakly porphyritic with beta-quartz forms; grades to quartz porphyry in zones of cleavage development; quartz may be bluish; locally reddish weathering; locally contains epidote and/or chlorite clots possibly pseudomorphic after hornblende; feldspar and quartz grains resist weathering and produce a bumpy surface; plagioclase and quartz phenocrysts sit in a granophyric matrix of alkali feldspar and quartz. Correlative to the Chatham granite of Hauck (1977). Also mapped by Wilkerson (1978).

Zgr-gd

Zgr-gd – Granite to granodiorite: Leucocratic, fine- to medium-grained, metamorphosed, granite to granodiorite, locally brecciated and altered.

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. Locally, microdiorite to andesitic-textured rock present.

Metavolcanic and Metavolcaniclastic Units

Uwharrie Formation

Zue/pl-A

Zue/pl-A - Uwharrie Formation mixed epiclastics, pyroclastics and lavas of Alamance County: Grayish-green to greenish-gray, metamorphosed tuffaceous sandstones, conglomeratic sandstones, siltstones and minor phyllite. The siltstones typically are weakly phyllitic. Contains lesser amounts of tuff and intermediate to mafic lavas. Quartz and feldspar crystal fragments are common in the sedimentary components, tuffs and lavas. Similar looking rocks in Chatham County yielded an U-Pb zircon age of 548.7 ± 1.1 Ma (Goliber, 2020). The unit is interpreted to be in unconformable contact with adjacent Hyco Formation units.

Hyco Formation

Zhhar

Zhhar – Hydrothermally altered rocks: Mixed unit of hydrothermally altered rocks consisting of: dense siliceous cryptocrystalline rock; quartz-pyrophyllite rocks, +- kaolinite, andalusite, chloritoid, sericite, paragonite and iron oxides; quartz-sericite rocks, +- paragonite, k-feldspar and iron oxides; and quartz-chloritoid-chlorite rocks, +- sericite and hematite. Described in detail by Hughes (1987) and Schmidt et al. (2006).

Zhat

Zat – Altered tuffs: Very light gray to light greenish-gray (whitish in areas) with red and yellow mottling. Alteration consists of silicified, sericitized and pyrophyllitized rock. Sericite phyllite, pods of pyrophyllite, and quartz + pyrophyllite rock all with less than c1 mm to 2 mm diameter weathered sulfides are common. Fine-grained chloritoid porphyroblasts (less than 1 mm) are present in some pyrophyllite bearing rocks. 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.

Zhat/vcs

Zhat/vcs: Altered tuffs and volcaniclastic sedimentary rocks: Mixed unit of altered volcaniclastic rocks and volcaniclastic sedimentary rocks. Alteration consists of silicified, sericitized and pyrophyllitized rock. Chloritoid locally present. Volcaniclastic sedimentary rocks include conglomeratic siltstone to conglomerate that may be variably altered. Includes area of quartz-sericite-paragonite rock (Zvqs) of Schmidt et al. (2006). Massive quartz locally present.

Zhe/p

Zhe/p - Mixed epiclastic-pyroclastic rocks: Green, grayish-green to greenish-gray; tuffaceous sandstones, conglomeratic sandstones, siltstones and minor phyllite. The siltstones typically are weakly phyllitic. Contains lesser amounts of coarse tuff and lapilli tuff. Silicified and/or sericitized altered rock similar to Zat unit are present near contacts with other units. Minor andesitic to basaltic lavas and tuffs.

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 and increase in occurrence toward the north. Conglomerates and conglomeratic sandstones typically contain subrounded to angular clasts of dacite in a clastic matrix. Fine- to medium-grained diorite is locally present. 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.

Zhp/e

Zhp/e - Mixed pyroclastic-epiclastics: Gray to green, felsic tuffs interlayed with mudstone, siltstone, and sandstone and distinctive immature, monomictic, conglomeratic sandstone to conglomerate containing subangular to angular clasts of plagioclase porphyritic dacite. Minor andesitic to basaltic lavas and tuffs.

Zhabsi

Zhabsi - Andesitic to basaltic shallow intrusive of the Hyco Formation: Grayish-green to light green, metamorphosed: plagioclase porphyritic andesite to basalt with a granular-textured groundmass to very fine-grained diorite and gabbro (with intrusive texture visible with 7x hand lens – microdiorite/microgabbro). Contains lesser amounts of fine- to medium-grained diorite and gabbro. Plagioclase phenocrysts typically range from 1 mm to 4 mm. Dark green to black colored amphibole, when present, occur as phenocrysts (less than 1 mm to 1 mm) and as intergrowths with plagioclase.

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 pyroclastic rocks and meta-sediments identical to the Zhe/pl unit.

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 is common. Welded and non-welded tuffs associated with the lavas include: greenish-gray to grayish-green, fine tuff, coarse plagioclase crystal tuff and lapilli tuff. Locally, interlayers of immature conglomerate and conglomeratic sandstone with abundant dacite clasts are present. The dacites are interpreted to have been coherent extrusives or very shallow intrusions associated with dome formation. The tuffs are interpreted as episodic pyroclastic flow deposits, air fall tuffs or reworked tuffs generated during formation of dacite domes. The unit occurs as map scale pods surrounded by clastic rocks of Zhe/pl unit. Wortman et al. (2000) 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.

Zhdlt-a

Zhdlt-a – Altered dacitic lavas and tuffs of the Hyco Formation: Very light gray to light greenish-gray (whitish in areas) with red and yellow mottling, altered and metamorphosed dacitic lavas and tuffs. Alteration consists of silicified, sericitized and pyrophyllitized rock. Relict structures are obliterated in heavily altered rocks.

Zhdlt-absi

Zhdlt-absi – Dacitic lavas and tuffs of the Hyco Formation infested by andesitic to basaltic dikes: Mixed unit of metamorphosed dacitic lavas and tuffs of the Zhdlt unit intruded by plagioclase porphyritic andesite to basalt.

Zhdsi (u)

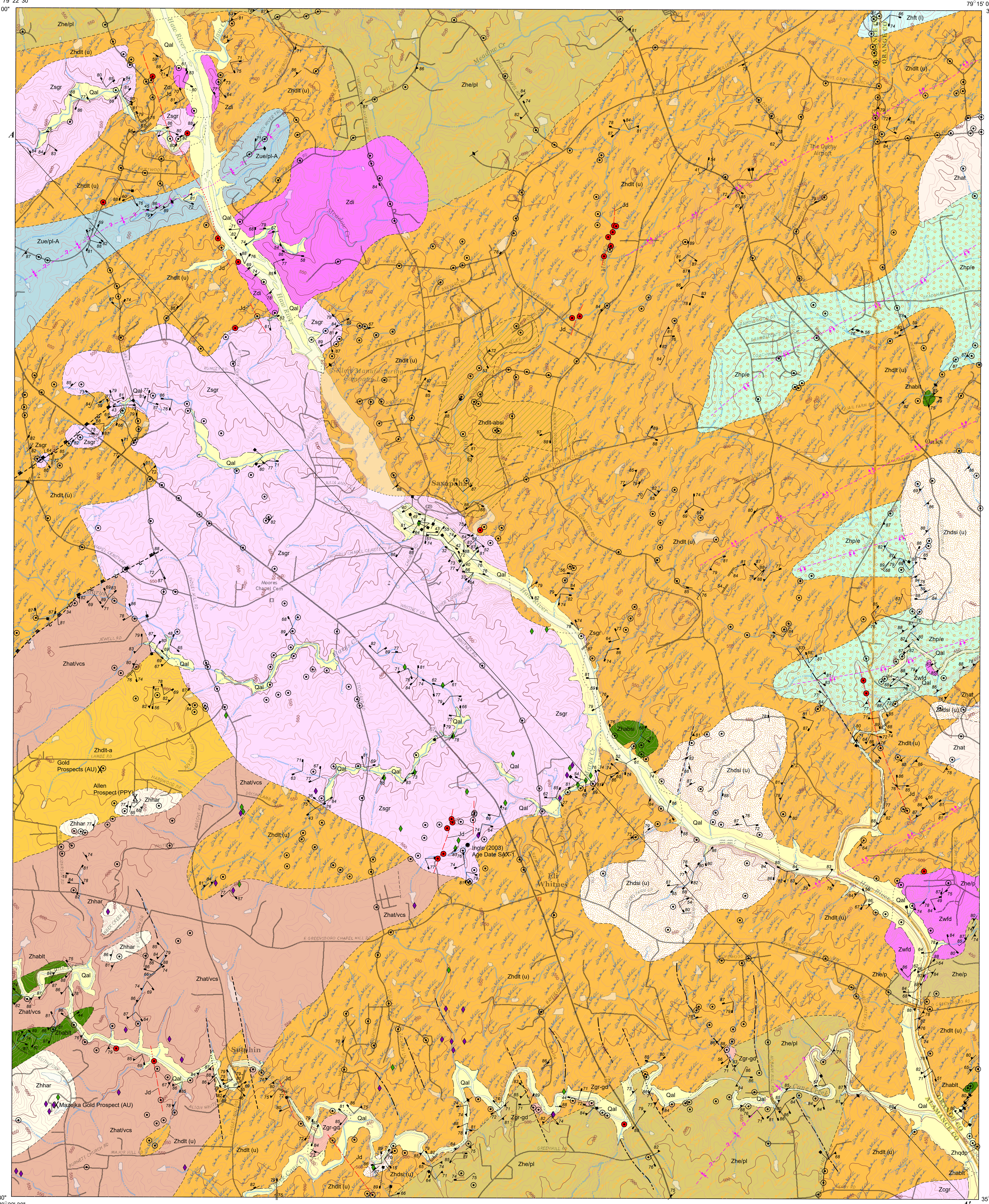
Zhdsi (u) - Dacitic shallow intrusive of the upper portion of the Hyco Formation: Gray-green, light green to green, greenish-gray to light gray; dacite, plagioclase porphyritic dacite with a granular-textured groundmass to micro-granodiorite (intrusive texture visible with 7x hand lens). Locally fine- 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.

Zhqdp

Zhqdp - Quartz dacite porphyry: Strongly 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; local weak alignment of plagioclase; interpreted as either lava flows or shallow intrusives possibly associated with domes.

Zhft (l)

Zhft (l) - Felsic tuffs: Grayish-green to greenish-gray and silvery-gray; massive to foliated volcaniclastic pyroclastic rocks consisting of fine- to coarse tuffs, lapilli tuffs and minor welded tuffs. Tuffs are differentiated from other volcaniclastic rocks by the presence of zones of cryptocrystalline texture that exhibit conchoidal-like fractures in between foliation domains. Layering ranges from massive to thinly bedded. Contains lesser amounts of volcaniclastic sedimentary rocks consisting of volcanic sandstones, and greywackes with minor siltstones and phyllite.



EXPLANATION OF MAP SYMBOLS

CONTACTS, FAULTS, AND OTHER FEATURES

inferred contact, dotted where concealed

inferred diabase, dotted where concealed

surficial units contact

linear geomorphic feature interpreted from hillshade LiDAR - origin uncertain

cross section line

inferred brittle fault, dotted where concealed

inferred high-angle reverse fault, existence questionable

interpreted fold hinge of overturned anticline; dotted where concealed, queried where questionable

interpreted fold hinge of syncline; dotted where concealed, queried where questionable

interpreted fold hinge of overturned syncline; dotted where concealed, queried where questionable

IN CROSS SECTION

contact

inferred fold axis

PLANAR, LINEAR AND OTHER FEATURES

strike and dip of bedding or layering (multiple observations at one location)

strike and dip of foliation

strike of vertical foliation

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

strike of vertical foliation (multiple observations at one location)

cataclastic foliation

strike and dip of cleavage

observation station location

diabase station location

Ingle (2003) SAX-1 age date approximate location

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

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

clast lineation

prospects [gold (AU) and pyrophyllite (PPY)]

whole rock analysis (USGS OFR 2006-1259)

composite rock chip samples (USGS OFR 2006-1259)

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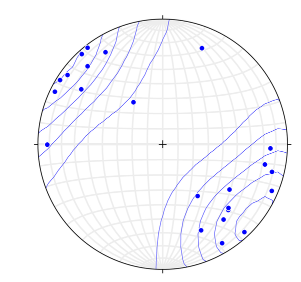
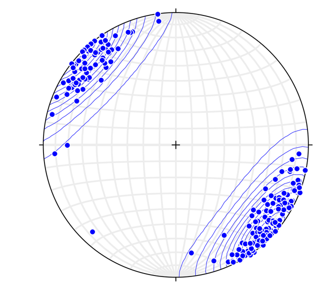
Equal Area Schmidt Net Projections and Rose Diagram

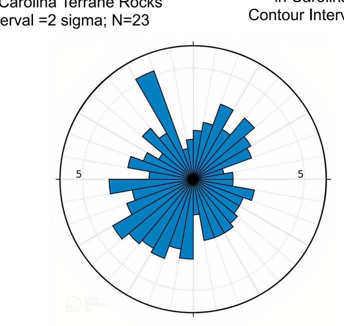
Plots and calculations created using Stereonet v. 10.2.0 based on Allmendinger et al. (2013) and Cardozo and Allmendinger (2013)



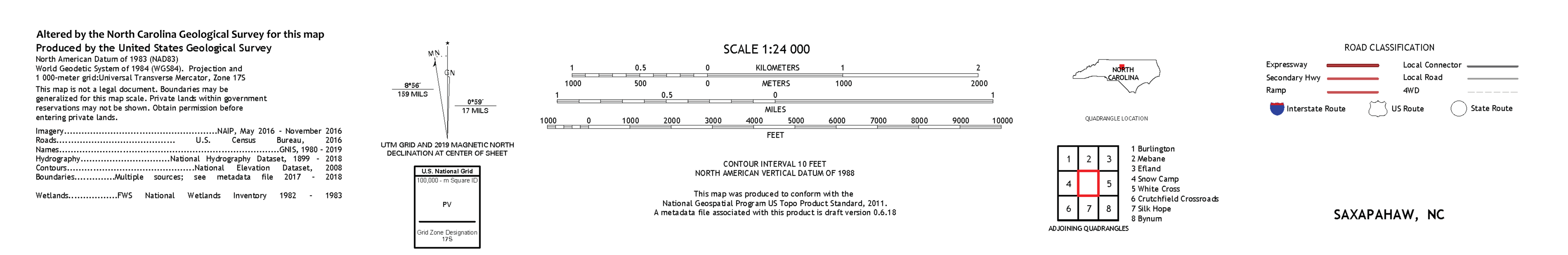
Equal Area Schmidt Net Projection of Contoured Poles to Primary Bedding, Layering and Welding/Compaction Foliation in Carolina Terrane Rocks
Contour Interval =2 sigma; N=23

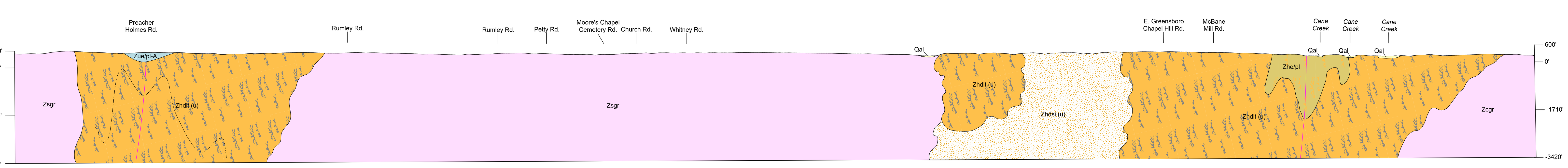


Equal Area Schmidt Net Projection of Contoured Poles to Foliation and Cleavage in Carolina Terrane Rocks
Contour Interval = 2 sigma; N=218



Unidirectional Rose Diagram of Joints
N=503 Outer Circle = 6%
Mean vector = 34°





no vertical exaggeration for bedrock units
Qal thickness exaggerated to be visible

Geologic Map of the Saxapahaw 7.5-Minute Quadrangle, Alamance and Orange Counties, North Carolina

By
Philip J. Bradley, Emily K. Michael,
Heather D. Hanna and Edward F. Stoddard

Geologic data collected in 2007, summer 2010 and June 2021 to May 2022.
Supersedes NCGS OFR 2011-04

Map preparation, digital cartography and editing by
Philip J. Bradley, Michael A. Medina and Emily K. Michael

2022

Saxapahaw Base Map Information: Base map is from USGS 2019 GeoPDF of the Saxapahaw 7.5-minute quadrangle. Air photo, map collar, contours and select features removed. Contour lines enhanced in Adobe Acrobat. Bounds of GeoPDF based on 7.5-minute grid projection in UTM 17S; North American Datum of 1983 (NAD83).

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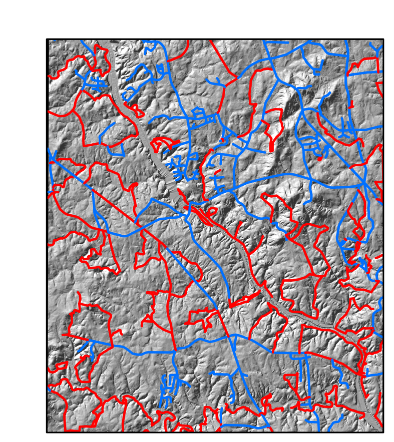

TRAVERSE MAP
by foot
by car