North Carolina Department of Environmental Quality
Division of Energy, Mineral and Land Resources
Brian L. Wrenn, Division Director
Kenneth B. Taylor, State Geologist

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North Carolina Geological Survey
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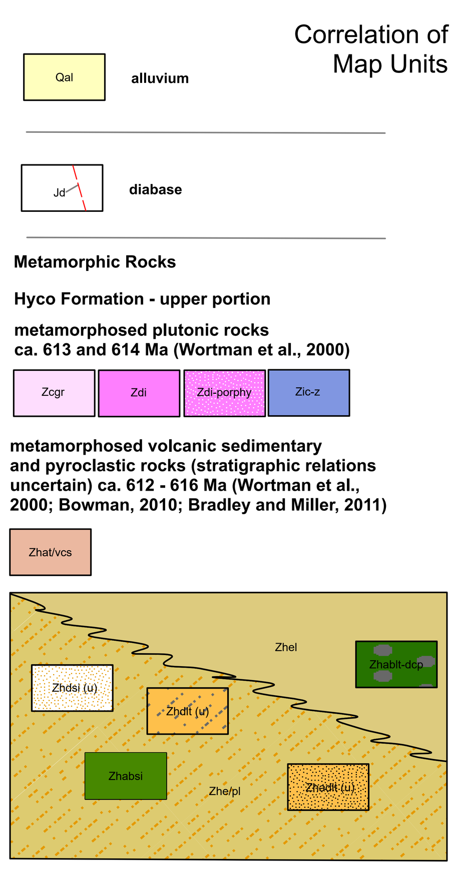


INTRODUCTION

The Silk Hope 7.5-minute Quadrangle lies in the east central portion of the North Carolina Piedmont. The Haw River crosses the northeastern corner of the quadrangle; the Chatham – Alamance County line crosses the northern portion of the quadrangle from west to east. The northeastern portion of the quadrangle is crossed by the northwest-southeast trending NC Highway 87. US Hwy 64, a major east-west corridor for the central Piedmont, is located immediately to the south of the quadrangle.

The majority of the quadrangle drains to the Haw River along drainages that include Dry Creek, Terrells Creek, Lick Creek, South Fork Cane Creek, Big Branch and other named and unnamed creeks. Small portions of the southwest and southeast of the quadrangle drain to small tributaries of the Rock River and include Harlands Creek and other unnamed tributaries. 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 northern extension of Hickory Mountain is located in the southern portion of the quadrangle and is a geologically controlled prominent topographic ridge that separates the Haw and Rocky River drainage basins. Hickory Ridge is underlain by resistant metamorphosed andesites to basalts. The elevations in the map area range from above 770 feet above sea level southwest of the intersection of Wade Harris Road and Silk Hope Lindley Mill road in the west central portion of the quadrangle, to less than 390 feet along the Haw River near the northeastern corner of the quadrangle.

Geologic Background and Past Work

Pre-Mesozoic crystalline rocks in the Silk Hope 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 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) 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 of 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 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 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 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. 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. NCGS detailed mapping identified one abandoned flagstone quarry, one abandoned crushed stone quarry, one prospect pit (commodity unknown) and one prospect pit for copper as indicated by the landowner. Schmidt et al. (2006) identified the Zackary Gold Mines (2 shafts) and the Braxton Mine shaft (gold) in the northern portion of the quadrangle. Field work by NCGS staff in 2021 did not find the shafts however abundant quartz float was present in the immediate vicinities. The USGS Mineral Resources Data System (MRDS) identified the Ivey Prospect for pyrophyllite in the northern portion of the quadrangle.

Parts of the northern portion of the quadrangle were mapped at reconnaissance-scale 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 west.

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. (2017a), Bradley et al. (2017b) and Hanna et al. (2015) from the Crutchfield Crossroads, Siler City and Siler City NE geologic maps, respectively, were used for conformity with on strike units in neighboring quadrangles. Unit descriptions and stratigraphic correlations were maintained from adjacent mapping in Orange County (Bradley et al., 2016). The nomenclature of the International Union of Geological Sciences subcommission on igneous and volcanic rocks (IUGS) after Le Maitre (2002) is used in classification and naming of the units. The classification and naming of the rocks is based on relict igneous textures, modal mineral assemblages, or normalized mineral assemblages when whole-rock geochemical data is available. Pyroclastic rock terminology follows that of Fisher and Schminke (1984).

Sedimentary Units

Qal

Qal – Alluvium: Unconsolidated poorly sorted and stratified deposits of angular to subrounded clay, silt, sand and gravel- to boulder-sized clasts, in stream drainages. May include point bars, terraces and natural levees along larger stream floodplains. Structural measurements depicted on the map within Qal represent outcrops of crystalline rock inliers surrounded by alluvium.

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.

Zic-z

Zic-z: Igneous complex of the Zachary Mines area – Andesite to basalt, diorite to gabbro and granite. Includes microdiorite textured rock. Massive quartz locally present. Whole rock analyses of several rocks provided by Schmidt et al. (2006). Part of the Ztm unit of Schmidt et al. (2006).

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 a 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). May be genetically related to Zhqdp in the Bynum Quadrangle unit.

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.

Zdi-porphy

Zdi-porphy - Diorite porphyry of the Silk Hope Quadrangle: Mesocratic to almost melanocratic, greenish-gray to gray diorite porphyry with fine- to medium-grained groundmass and euhedral phenocrysts (up to 18 mm) of light gray to white plagioclase. Plagioclase crystals can be saussuritized. Unit locally includes mesocratic, equigranular, plagioclase+amphibole, fine- to medium-grained intrusive diorite to monzodiorite.

Metavolcanic and Metavolcaniclastic Units

Hyco Formation – Upper Portion

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.

Zhel

Zhel - Epiclastic rocks and lavas: Metamorphosed 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. Correlative in part to Haw River sequence of Hauck (1977). Clasts of Zhablt-dcp occur locally in conglomerates of the unit adjacent to outcrop area of Zhablt-dcp.

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.

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, occurs as phenocrysts (less than 1 mm to 1 mm) and as intergrowths with plagioclase.

Zhablt-dcp

Zhablt-dcp – Andesite to basalt porphyry of the Dry Creek area: Distinctive, green to dark green, metamorphosed andesite porphyry with aphanitic groundmass and euhedral phenocrysts (up to 10 mm) of greenish-white plagioclase; phenocrysts typically constitute 20 to 50% of the rock; local alignment of plagioclase; lesser pyroxene/amphibole phenocrysts. Green to dark green basalt porphyry with abundant pyroxene (altered to amphibole) phenocrysts with minor plagioclase phenocrysts. Andesite and basalt porphyries locally amygdaloidal (up to 2 cm), amygdules in filling include calcite, quartz, chlorite, and epidote. Same as Dry Creek Porphyry complex of Hauck (1977).

Zhablt

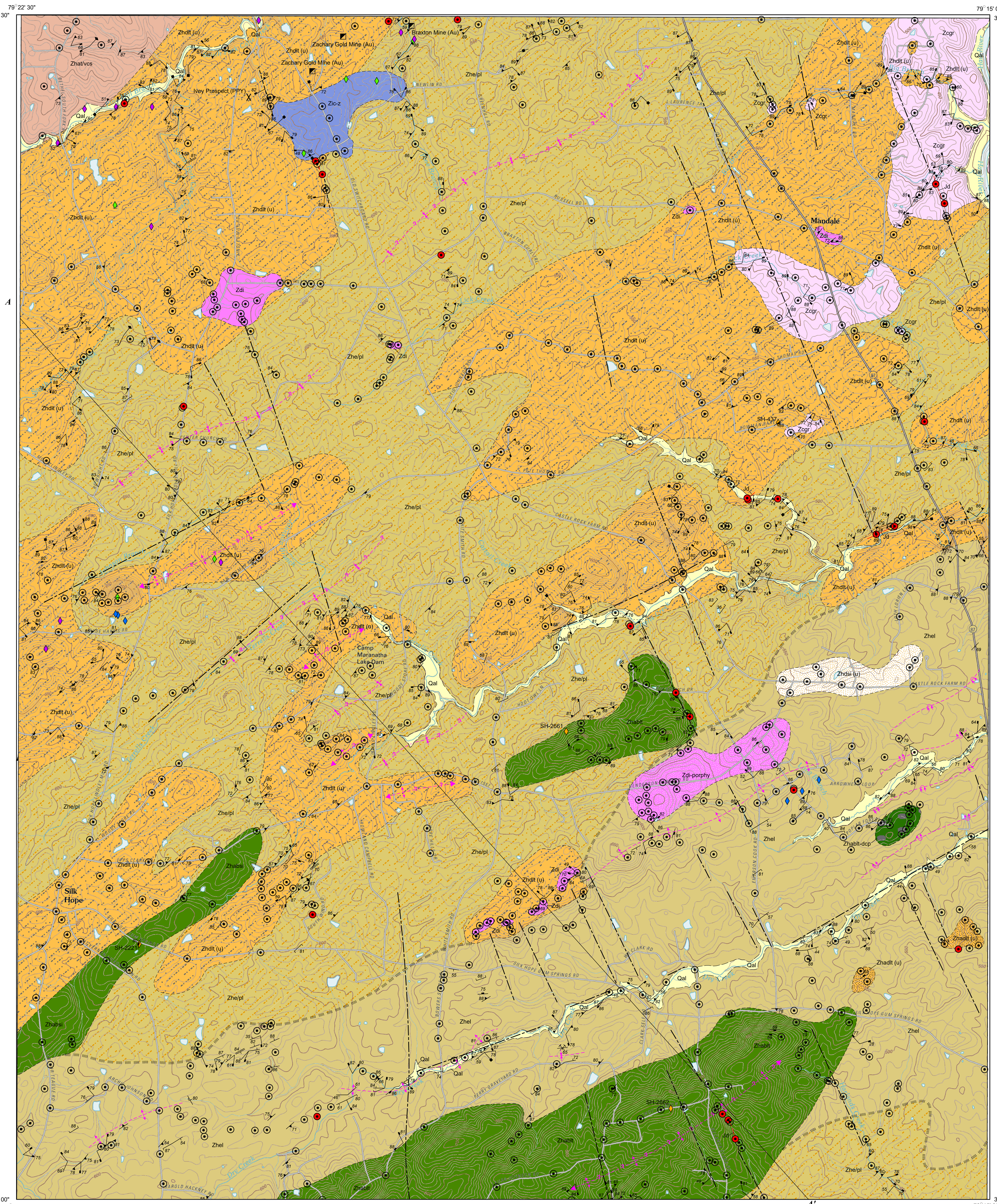
Zhablt - Andesitic to basaltic lavas and tuffs: Green, gray-green, gray, dark gray and black; typically unfoliated, amygdaloidal, plagioclase porphyritic, amphibole/pyroxene porphyritic and aphanitic; andesitic to basaltic lavas and shallow intrusions. Hyaloclastic texture is common and imparts a fragmental texture similar to a lithic tuff on some outcrops. Locally interlayered with pyroclastic rocks and meta-sediments identical to the Zhe/pl and Zhime/pl units.

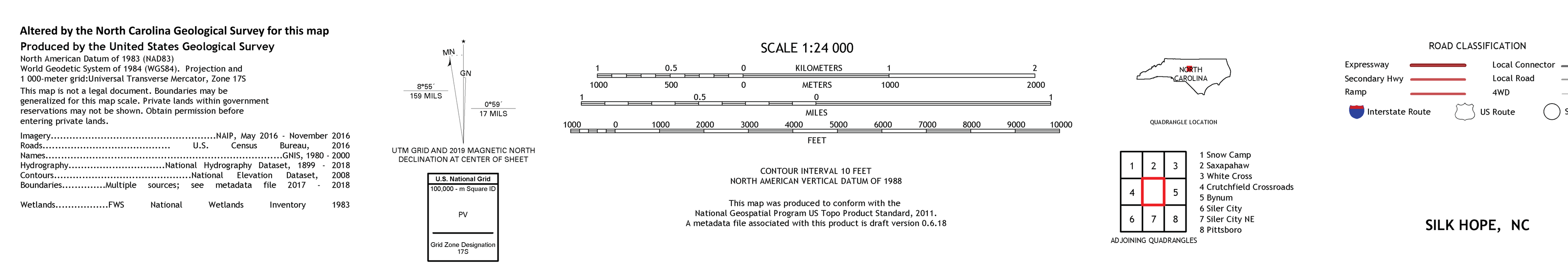
Zhdlt (u)

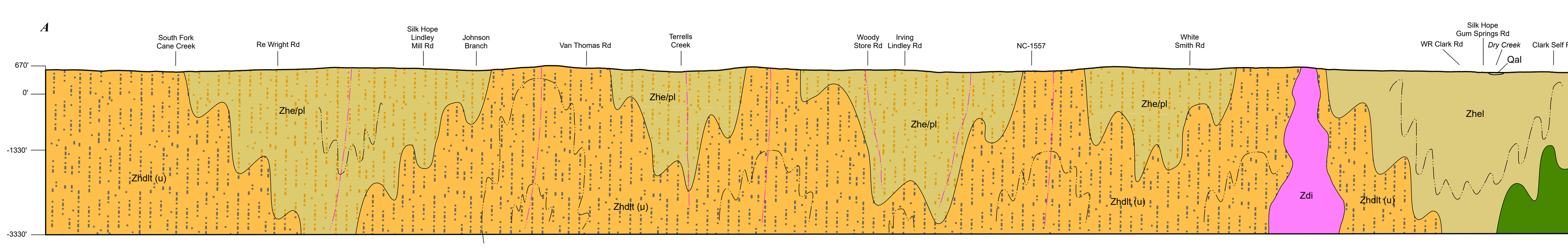
Zhdlt (u) – Dacitic lavas and tuffs of the upper portion of the Hyco Formation: Greenish-gray to dark gray, siliceous, metamorphosed: aphanitic dacite, porphyritic dacite with plagioclase phenocrysts, and flow banded dacite. Dacite with hyaloclastic textures are common. Welded and non-welded tuffs associated 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. 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.







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

EXPLANATION OF MAP SYMBOLS

CONTACTS, FAULTS, AND OTHER FEATURES

- inferred contact, dotted where concealed,
- inferred diabase
- Qal contact
- lineament - lidar inferred
- inferred brittle fault
- fold axis - inferred (syncline), ? where questionable
- fold axis - inferred (overturned syncline)
- fold axis - inferred (anticline), dotted where concealed, ? where questionable
- fold axis - inferred (overturned anticline), dotted where concealed
- doubly plunging anticline existence questionable
- gradational contact
- A — A' cross section line

IN CROSS SECTION

- contact
- inferred fold axis
- fold form lines

PLANAR AND LINEAR FEATURES

- 81 strike and dip of bedding or layering
- 84, 74 strike and dip of bedding or layering (multiple observations at one location)
- 80 strike and dip of overturned bedding
- 46 strike and dip of foliation
- 45, 51 strike and dip of foliation (multiple observations at one location)
- strike of vertical foliation
- strike of vertical foliation (multiple observations at one location)
- 62 strike and dip of cleavage
- 70, 57 strike and dip of cleavage (multiple observations at one location)
- 80 strike and dip of inclined joint
- 71, 68 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)
- 54 strike and dip of welding/compaction foliation

QUARRIES AND OTHER FEATURES

- observation station location
- quarry - crushed stone, abandoned
- mine shaft - abandoned
- prospect pit
- lithic samples of Steponaitis, et. al. (2006)
- SH-2221 geochemical sample location (NCGS)
- Whole-Rock Analyses (USGS OFR 2006-1259)
- Composite rock chip samples (USGS OFR 2006-1259)
- diabase station location

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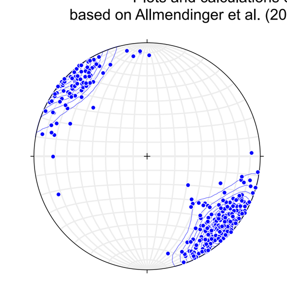
		MAJOR ELEMENTS IN WEIGHT PERCENT OXIDE													SELECTED TRACE ELEMENTS IN PPM or PPB**															
SAMPLE	MAP UNIT	SiO2	TiO2	Al2O3	Fe2O3*	MnO	MgO	CaO	Na2O	K20	P2O5	Cr_2O_3	LOI	TOTAL	Co	Ni	Cu	Zn	As	Rb	Sr	y	Zr	Mo	Ba	La	Cc	Nd	Sm	Au**
SH-437	Zhdlt (u)	73.33	0.33	13.72	2.48	0.11	0.33	1.11	5.75	2.14	0.04	<0.002	0.5	99.85	0.7	0.4	1.6	113	2.4	33.7	300	32.1	181.3	0.4	609	18.7	39.9	23.6	5.33	0.6
SH-2221	Zhabsi	46.86	3.07	14.23	14.55	0.26	4.58	9.61	2.76	0.6	0.95	0.002	2.3	99.75	29.1	7.7	18.4	74	1.8	14	440.2	31.1	91.6	0.2	196	14.9	38.6	29.4	7.33	1.1
SH-2661	Zhablt	51.52	1.51	15.65	11.57	0.19	4.37	8.88	2.84	0.26	0.39	<0.002	2.6	99.76	26.9	6.5	64.5	101	1.4	3	558.4	20.1	54.7	0.2	174	6.9	17.3	13	3.5	<0.5
SH-2662	Zhablt	53.01	1.09	15.73	11.99	0.19	3.8	8.08	2.99	0.33	0.18	0.005	2.4	99.8	27.3	5.1	7	83	0.9	3.7	406.1	20.8	59 .4	0.1	186	6.4	16.3	12.1	3.16	1.2

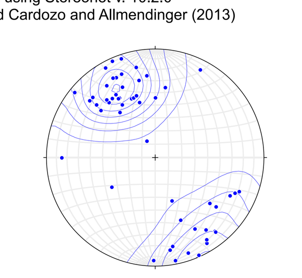
Major and trace Element geochemical analyses completed by Acme Labs, Vancover, Canada. ICP-ES and ICP-MS whole rock analyses using method code LF202. Total iron measured as Fe_2O_3 *
**All trace elements are in PPM (parts per million) except Au which is in PPB (parts per billion)
LOI = loss on ignition

Equal Area Schmidt Net Projections and Rose Diagram

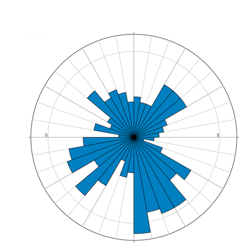
Plots and calculations created using Stereonet v. 10.2.0 based on Allmendinger et al. (2013) and Cardozo and Allmendinger (2013)



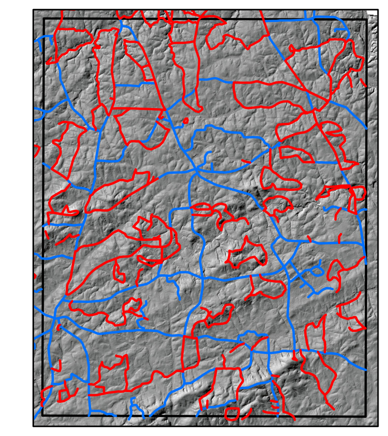
Equal Area Schmidt Net Projection of Contoured Poles to Foliation and Cleavage in Carolina Terrane Rocks
Contour Interval = 2 sigma; N=332



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=53



Unidirectional Rose Diagram of Joints N=339
Outer Circle = 6%
Mean vector = 359°



TRAVERSE MAP
by foot
by car

Geologic Map of the Silk Hope 7.5-Minute Quadrangle, Chatham and Alamance Counties, North Carolina

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

Geologic data collected in May 2013 through May 2014 and through March to June 2021.

Supersedes NCGS OFR 2014-02

Map preparation, digital cartography and editing by
Michael A. Medina, Heather D. Hanna and Emily K. Michael
2022

Base map is from USGS 2019 GeoPDF of the Silk Hope 7.5-minute quadrangle. Air 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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