DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
DIVISION OF ENERGY, MINERAL, AND LAND RESOURCES
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NORTH CAROLINA GEOLOGICAL SURVEY
OPEN FILE REPORT 2014-02

Quaternary

Qal — alluvium

Mesozoic

Jd — diabase

Neoproterozoic

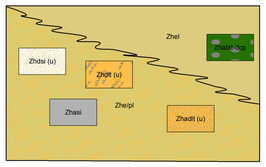
Metamorphic Rocks

Hyco Formation - upper portion

metamorphosed plutonic rocks
ca. 613 and 614 Ma (Wortman et al., 2000)

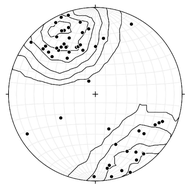
Zgr | Zdi | Zdi-porphyritic

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

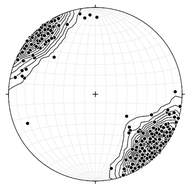


Equal Area Schmidt Net Projections and Rose Diagram

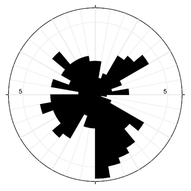
Plots and calculations created using Stereonet v. 8.6.0 based on Allmendinger et al. (2013) and Cardozo and Allmendinger (2013)



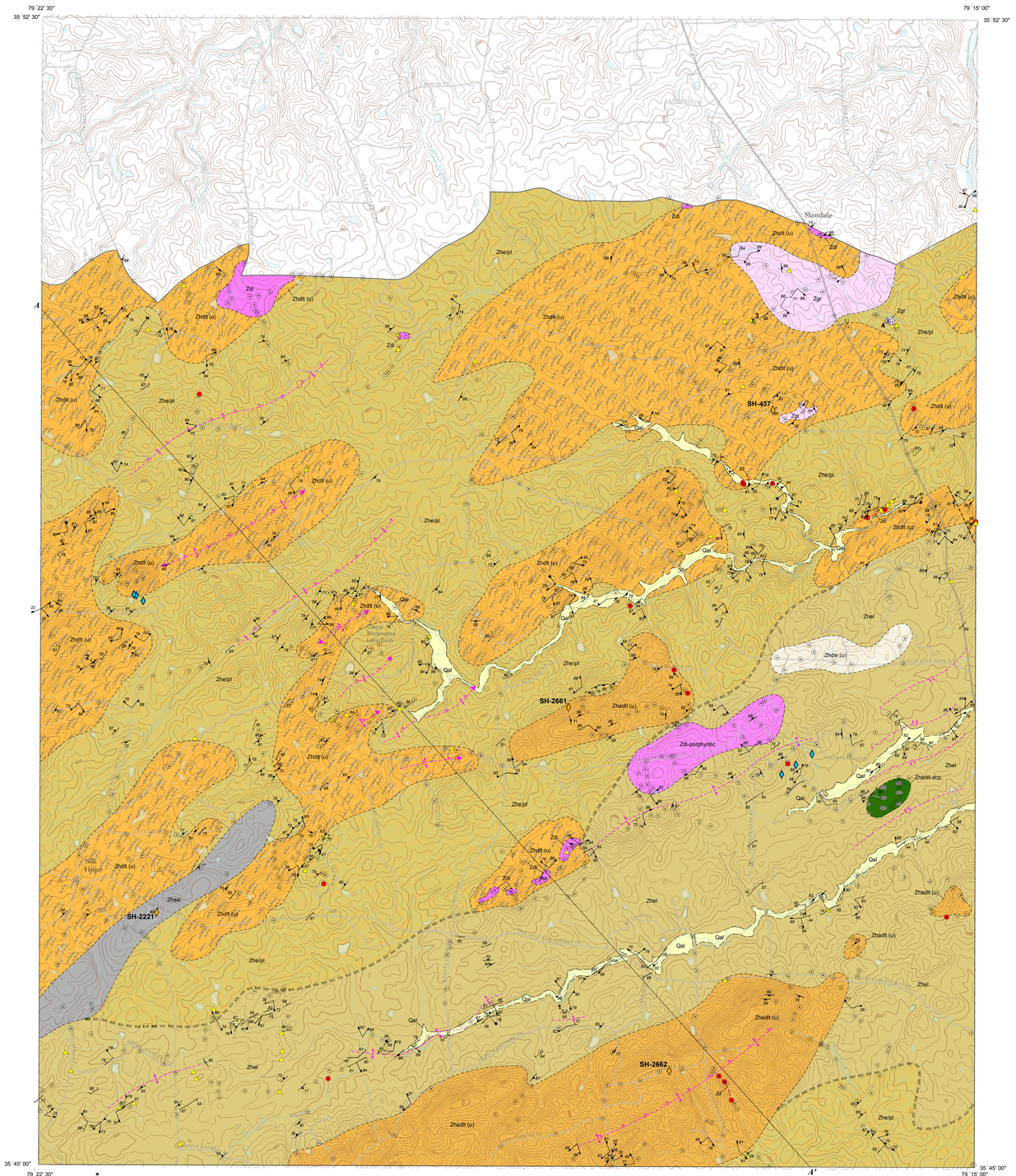
Equal Area Schmidt Net Projection of
Contoured Poles Primary Bedding and Layering
Contour Interval = 2 sigma N = 52



Equal Area Schmidt Net Projection of
Contoured Poles to Foliation and Cleavage
Contour Interval = 2 sigma N = 277



Unidirectional Rose Diagram of Joints N = 259
Outer Circle = 6%
Mean vector = 205 degrees



SCALE 1:24 000

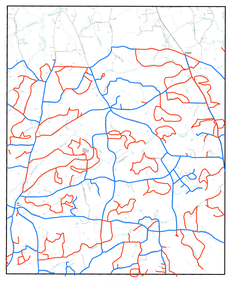
1 0.5 0 1 Miles
1,000 500 0 1,000 2,000 3,000 4,000 5,000 6,000 7,000 Feet
1 0.5 0 1 Kilometers

CONTOUR INTERVAL - 10 FEET

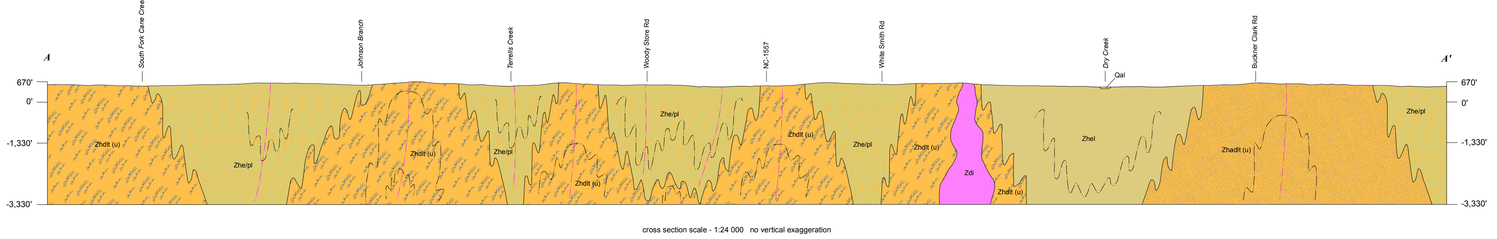
MN
8° 26'

2010 Magnetic North Declination at Center of Sheet = 8 degrees 26 minutes West

Geologic data collected May 2013 through May 2014.



TRAVERSE MAP
by foot
by car



cross section scale - 1:24 000 no vertical exaggeration

		MAJOR ELEMENTS IN WEIGHT PERCENT OXIDE												SELECTED TRACE ELEMENTS IN PPM or PPB**																
SAMPLE	MAP UNIT	SiO_2	TiO_2	Al_2O_3	Fe_2O_3*	MnO	MgO	CaO	Na_2O	K_2O	P_2O_5	Cr_2O_3	LOI	TOTAL	Co	Ni	Cu	Zn	As	Rb	Sr	Y	Zr	Mo	Ba	La	Ce	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	Zhasi	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	Zhadlt (u)	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	Zhadlt (u)	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, Vancouver, 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

GEOLOGIC MAP OF THE CHATHAM COUNTY PORTION OF THE SILK HOPE 7.5-MINUTE QUADRANGLE, CHATHAM AND ALAMANCE COUNTIES, NORTH CAROLINA

By Heather D. Hanna and Philip J. Bradley

Digital representation by Michael A. Medina and Heather D. Hanna

2014

DESCRIPTION OF MAP UNITS

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 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 can be locally overturned to the southeast. Jurassic-aged diabase dikes intrude the crystalline rocks of the map area. Quaternary-aged alluvium is present in most major drainages.

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 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 is needed to confirm this interpretation.

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 the Bynum quadrangle (Bradley et al., 2013) and nearby detailed geologic maps (see Bradley, 2013) were used for conformity with on strike units in neighboring quadrangles. The nomenclature of the International Union of Geological Sciences subcommission on igneous and volcanic rocks (IUGS) sffer 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 in the Silk Hope quadrangle and adjacent areas (Hauck, 1977; Wilkinson, 1978; Schmidt et al., 2006) have used various nomenclature systems for the igneous rocks. To assist in naming of units, select raw data of earlier workers, when available from neighboring quadrangles, were recalculated and plotted on ternary diagrams and classified based on IUGS nomenclature. Pyroclastic rock terminology follows that of Fisher and Schmincke (1984).

SEDIMENTARY UNIT

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.

INTRUSIVE UNIT

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.

METAINTRUSIVE UNITS

Hyco Formation – Upper Portion

Zgr

Zgr – Granite: 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) as identified by Wilkinson (1978).

Zdi

Zdi – Diorite: Mesocratic (CI~50), greenish-gray to grayish-green, fine- to coarse-grained, hypidiomorphic granular diorite to quartz monzodiorite. Major minerals include plagioclase and amphibole. Plagioclase crystals are typically sericitized and saussuritized. Amphiboles are typically altered to chlorite and actinolite masses. May be gabbroic locally. Quartz monzodiorite of unit identified northeast of Sapling Ridge Church.

Zdi-porphyritic

Zdi-porphyritic: Diorite porphyry: 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 may be saussuritized. Unit locally includes equigranular, diorite to monzodiorite like Zdi unit.

METAVOLCANIC UNITS

Hyco Formation - Upper Portion

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. Correlative in part to Haw River sequence of Hauck (1977).

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 relict vitric texture. 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 vitric groundmass. 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.

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. 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 and/or Zhel units. 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. Locally include andesites identical to Zhasi unit – especially on prominent ridge in southern portion of quadrangle. Interlayed with the lavas are gray to black; welded and non-welded; coarse tuff, lapilli tuff, and tuff breccia. Locally interlayered with meta-sediments identical to adjacent Zhe/pl and/or Zhel units. Rocks interpreted as andesites have distinct interior weathering rind of light brown to gray and fresh surfaces exhibit weakly vitric like textures in contrast to dacites.

Zhasi

Zhasi - Andesitic shallow intrusive: Grayish-green to light green, plagioclase porphyritic andesite with a granular-textured groundmass to very fine-grained diorite (with intrusive texture visible with 7x hand lens). Contains lesser amounts of fine- to medium grained diorite. 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.

Zhabit-dcp

Zhabit-dcp – Andesite to basalt porphyry of the Dry Creek area: Distinctive, green to grayish-green, andesite porphyry with aphanitic groundmass and euhedral phenocrysts (up to 20 mm) of greenish-white plagioclase; phenocrysts typically constitute 20 to 50% of the rock; lesser pyroxene/amphibole phenocrysts. Correlative to Dry Creek Porphyry complex of Hauck (1977).

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CONTACTS, FOLDS AND OTHER FEATURES

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

- lithologic contact-inferred
- lithologic contact-concealed
- gradational contact-inferred
- brittle fault-inferred
- Qal contact
- diabase dike - inferred
- interpreted fold hinge of large scale anticline; question mark where existence is questionable; dotted where concealed; arrow indicates direction of plunge
- interpreted fold hinge of large scale syncline; question mark where existence is questionable; dotted where concealed; arrow indicates direction of plunge
- interpreted fold hinge of large scale overturned anticline
- interpreted fold hinge of large scale overturned syncline
- A A' cross section line
- in cross section, fold form lines
- in cross section, inferred axial trace of large-scale fold

- strike and dip of inclined primary bedding and/or layering
- strike and dip of inclined primary bedding and/or layering (multiple observations at one locality)
- strike and dip of inclined overturned primary bedding
- 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
- 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)
- 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)
- diabase station location
- station location
- station location with conspicuous amounts of quartz cobbles and/or boulders
- FBL lithic samples of Steponaitis et al. (2006)
- SH-437 geochemical sample location (NCGS)
- 4 X prospect pit
- 2 quarry - abandoned

1. quarry (flagstone) – abandoned
2. quarry (crushed stone) – abandoned
3. prospect pit (commodity unknown) – abandoned
4. prospect pit (copper) - abandoned

Base map is from USGS 2010 GeoPDF of the Silk Hope 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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Randy Bechtel assisted in data collection.

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