NORTH CAROLINA DEPARTMENT OF ENVIRONMENT AND NATURAL RESOURCES
DIVISION OF LAND RESOURCES
James D. Simons, Director and State Geologist

This geologic map was funded in part by the USGS National Cooperative Geologic Mapping Program

NORTH CAROLINA GEOLOGICAL SURVEY
OPEN FILE MAP 2011-06

Accompanying Map of the Orange County and Adjacent Portions of the Mebane 7.5-Minute Quadrangle, Orange and Alamance Counties, North Carolina
Open File Map 2011-06

MAP UNITS

QUATERNARY
- Qal — Alluvium

JURASSIC
- Jd — Diabase

NEOPROTEROZOIC
- CZgd-gb — Granodiorite to gabbro (Zgd-gb)

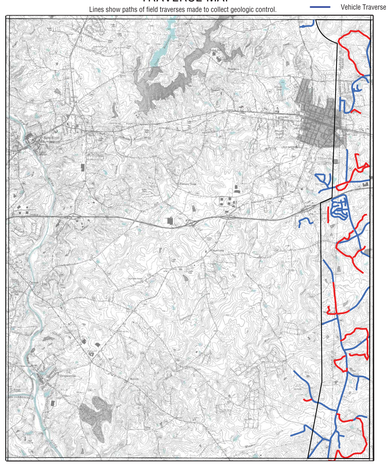
Hyco Formation Metavolcanic Units
ca. 615 to 633 ma (Wortman et. al, 2000; Bradley and Miller, 2011)

- Zhe — Epiclastics
- Zhe/p — Mixed epiclastic-pyroclastic rocks
- Zhdlt (u) — Dacitic lavas and tuffs
- Zhablt — Andesitic to basaltic lavas and tuffs
- Zhdlt (l) — Dacitic lavas and tuffs
- Zhft (l) — Felsic tuffs

TRAVERSE MAP

Lines show paths of field traverses made to collect geologic control.

Foot Traverse
Vehicle Traverse



EXPLANATION OF MAP SYMBOLS

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

- Contact - location inferred
- Contact - location concealed
- Qal Contact - location inferred
- Jd Dike - location inferred
- Inferred fold hinge of overturned anticline, plunging and non-plunging, dotted where concealed
- Inferred fold hinge of overturned syncline, plunging and non-plunging, dotted where concealed

STRIKE AND DIP OF PLANAR FEATURES

Observation sites are centered on the strike bar, or at the intersection point of multiple symbols.

- 33 — Strike and dip of primary bedding and layering
- 42 — Strike and dip of foliation
- Strike of vertical foliation
- 78 — Strike and dip of cleavage
- 88 — Strike and dip of joint
- Stike of vertical joint

BEARING AND PLUNGE OF LINEAR FEATURES

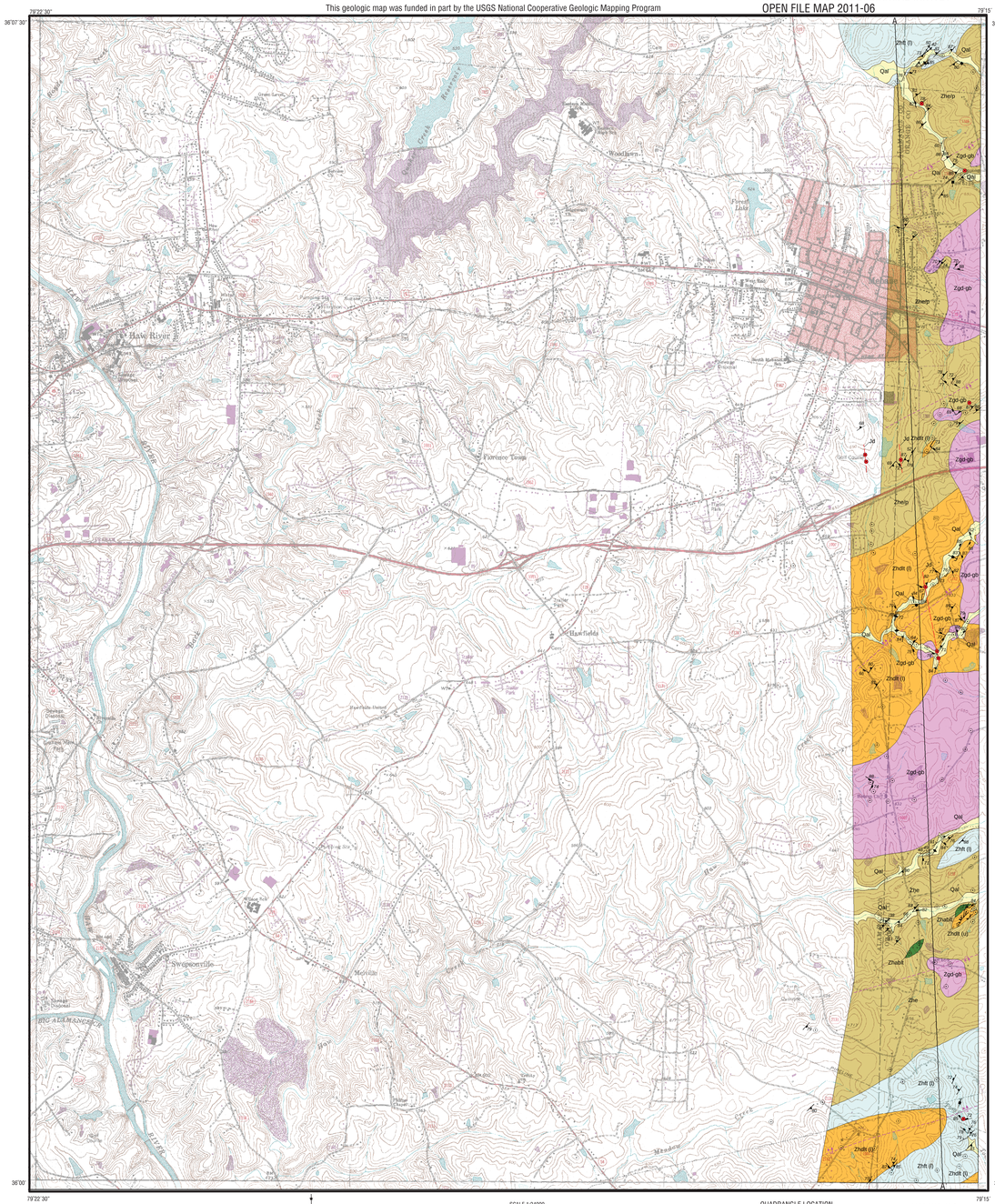
- 50 — Fold axis

NON-STRUCTURAL FEATURES

- Observation station location
- Diabase station location

EXPLANATION OF CROSS SECTION SYMBOLS

- In cross section, interpreted fold form lines of non-cylindrical asymmetric folds
- In cross section, inferred axial trace of large-scale fold



Topography mapped, edited and published by the U.S. Geological Survey

Control by USGS and NOS/NOAA

Topography by photogrammetric methods from aerial photographs taken 1967. Field checked 1969

MN
8 1/2°
2004 MAGNETIC NORTH DECLINATION
FROM CENTER OF NEARBY CHAPEL HILL QUADRANGLE

SCALE 1:24000
1 0.5 0 1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 0.5 0 1 KILOMETER
CONTOUR INTERVAL 10 FEET

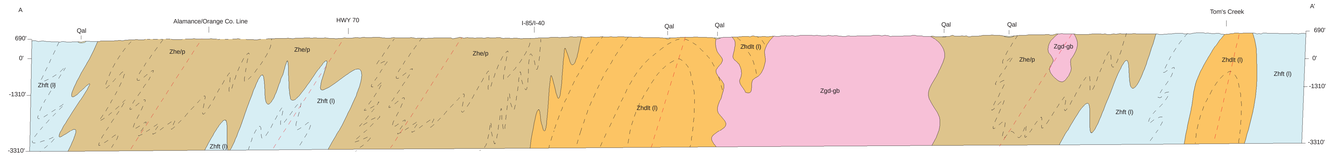
QUADRANGLE LOCATION

MEBANE, N.C.
35077-A1-TF-024
1969
REVISED 1994
DMA 5708 III SE-SERIES V842

This Open-File Map is preliminary. It has been internally reviewed for conformity with the North Carolina Geological Survey editorial standards. Further revisions or corrections to this Open File map may occur.

Research supported by the U.S. Geological Survey, National Cooperative Geologic Mapping Program, under USGS award number G10AC00425. The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either express or implied, of the U.S. Government.

The Orange County portion and adjacent areas of this quadrangle were mapped as part of a larger multi-year project to provide detailed geologic data to Orange County.



INTRODUCTION

Pre-Mesozoic crystalline rocks in the Mebane Quadrangle are part of the Neoproterozoic to Cambrian Carolina terrane. In the vicinity of the map area, the Carolina terrane can be separated into two lithotectonic sequences: 1) the Neoproterozoic Virgilina sequence and 2) Neoproterozoic to early Cambrian plutonic rocks. The Virgilina sequence consists of ca. 615 to 633 Ma (Wortman et. al, 2000; Bradley and Miller, 2011) layered volcaniclastic rocks and plutonic rocks. In southern Orange County, Virgilina sequence layered lithologies are intruded by the ca. 579 Ma (Tadlock and Loewy, 2006) East Farrington pluton and associated West Farrington pluton. The Virgilina sequence was 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; and Hibbard and Samson, 1995). In the map area, Virgilina sequence lithologies are interpreted to be steeply dipping due to open to isoclinal folds that are locally overturned to the southeast. In the Roxboro, NC area, folded Virgilina sequence lithologies were intruded by the ca. 546 Ma Roxboro pluton (Wortman et. al, 2000). In adjacent quadrangles to the north (Burlington Northeast) and northeast (Cedar Grove), the Prospect Hill tonalitic granodiorite pluton is interpreted to be related to the Roxboro pluton (Hanna et al., 2011 and Hanna et al., 2010, respectively).

Unit descriptions common to Bradley et al. (2006) from the Efland quadrangle and Hanna et al. (2010) from the Cedar Grove geologic map was used for conformity with on strike units in adjacent quadrangles. All pre-Mesozoic rocks of the Mebane quadrangle have been metamorphosed to at least the chlorite zone of the greenschist metamorphic facies. Many of the rocks display a weak or strong metamorphic foliation. Although subjected to metamorphism, the rocks retain relict igneous, pyroclastic, and sedimentary textures and structures that allow for the identification of protolith rocks. As such, the prefix "meta" is not included in the nomenclature of the pre-Mesozoic rocks described in the quadrangle. Jurassic diabase dikes are unmetamorphosed.

The nomenclature of the International Union of Geological Sciences subcommission on igneous and volcanic rocks (IUGS) after Le Maitre (2002) is used in classification and naming of the units. The classification and naming of the rocks is based on relict igneous textures, modal mineral assemblages, or normalized mineral assemblages when whole-rock geochemical data is available. Past workers in adjacent areas (Allen and Wilson, 1968 and Wilson, 1975) have used various nomenclature systems for the igneous rocks. The raw data, when available, of these earlier workers was recalculated and plotted on ternary diagrams and classified based on IUGS nomenclature. Pyroclastic rock terminology follows that of Fisher and Schmincke (1984).

DESCRIPTION OF MAP UNITS

SEDIMENTARY UNITS

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 AND META-INTRUSIVE UNITS

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.

Zgd-gb – Granodiorite to gabbro: Composite pluton of dominantly medium-grained, hornblende granodiorite; lesser amounts of medium-grained hornblende diorite, plagioclase porphyritic granodiorite, fine-grained granodiorite, and diorite; minor amounts of fine-grained gabbro. Fine-grained granodiorite and diorite are typically green in hand sample from sausseritization of plagioclase. Hornblende is typically altered to chlorite and actinolite masses.

METAVOLCANIC UNITS

Hyco Formation -- Upper Portion

Zhe - Epiclastics: Mixed unit of metasedimentary rocks. Lithologies present include mudstone, siltstone, sandy siltstone, sandstone, pebbly sandstone, and conglomerate. Mudstones are greenish-gray to gray, typically silicified, with continuous, parallel to slightly wavy, very thin to medium lamina occasionally with small-scale loading structures. Siltstones are light green-gray to gray, with continuous, parallel to slightly wavy, thin lamina to very thin beds, occasionally with small-scale loading structures. The siltstones are composed of quartz, sericite, and traces of a black detrital heavy minerals (<1 mm in diameter). Silstones are typically interbedded with the sandstones. Sandstones are dark-gray, gray, greenish-gray, grayish-green, litharenites and feldspathic lithurenites composed of volcanic rock fragments, feldspar, quartz, and rare intrusive rock fragments. Textures range from fine-grained, and well sorted to very coarse-grained, and moderately poorly sorted. Bedding in the sandstones is continuous, parallel to inclined, thin lamina to thin beds; also massive bedding and cross-beds are present. Individual beds are sometimes graded from sand-size to silt-size with abrupt upper surfaces. Conglomerates include matrix supported and clast supported polymictic conglomerate composed of angular to rounded, pebbles to large cobbles (up to 30 cm). Conglomerates are generally massive bedded, rarely with any imbrication of the clasts. Clast types include: dark-gray to gray, angular to subangular, microcrystalline volcanic rock fragments; black, subangular to subrounded, plagioclase-porphyritic dacite; black to dark gray, subrounded, flow-banded dacite; and greenish-gray to grayish-green, rounded to well rounded, fine to coarse plagioclase crystal tuff. Rare clast types include: white, subangular to rounded, granite and granodiorite (up to 12 cm); dark-brown, rounded, vesicular basalt (up to 2.5 cm); and gray, angular siltstone (up to 25 cm). Sandstone and conglomerate beds often fill scour channels in the siltstones.

Zhe/p - Mixed epiclastic-pyroclastic rocks: Grayish-green to greenish-gray; tuffaceous sandstones, conglomeratic sandstones, siltstones and minor phyllite. The siltstones typically are weakly phyllitic. Contains lesser amounts of fine to coarse tuff and lapilli tuff. Minor andesitic to basaltic lavas and tuffs present. Silicified and/or sericitized altered rock similar to Zhat unit are present near contacts with other units. Distinctive plagioclase + quartz crystal tuff present in lower zones of unit near contact with Zhft (l) unit.

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. 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 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 contact with the Zhp/e unit is interepreted to be gradational. Wortman et al. (2000) reports an age of 615.7+3.7/-1.9 Ma U-Pb zircon date for a dacitic tuff interpreted to be from the same unit within the Rougemont Quadrangle.

Zhablt – Andesitic to basaltic lavas and tuffs: Green, gray-green, black; amygdaloidal basalt, porphyritic basalt with plagioclase phenocrysts, porphyritic basalt with amphibole/pyroxene phenocrysts, and microcrystalline basalt. Tuffs associated with the lavas include: coarse plagioclase crystal tuff, with suasseritized pale green, angular to subrounded plagioclase crystal fragments (up to 3 mm) in a fine-grain matrix of epidote and chlorite; coarse amphibole/pyroxene crystal tuff with black, prismatic amphibole/pyroxene crystal fragments (up to 3 mm) in a fine-grain matrix of epidote and chlorite. Rounded weathering patterns of outcrops and amoeboid shaped structures in outcrop of some mafic lavas are interpreted as possible pillow structures. Basalts are interpreted to be lava flows or shallow intrusions.

Hyco Formation -- Lower Portion

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. 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. Minor andesitic to basaltic lavas and tuffs. Distinctive plagioclase + quartz crystal tuff present in unit in higher stratigraphic zones near the Zhe/p unit.

Zhdlt (l) - Dacitic lavas and tuffs of the lower portion of the Hyco Formation: Distinctive dark-gray to black, siliceous, cryptocrystalline dacite, porphyritic dacite with plagioclase ± quartz phenocrysts, and flow banded dacite. Welded and non-welded tuffs associated with the lavas include: greenish-gray to grayish-green, fine tuff, coarse plagioclase crystal tuff; lapilli tuff; and tuff breccia. The dacites are interpreted to have been coherent magma that were extrusive 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) report a 632.9 +2.6/-1.9 Ma zircon date from a sample within the unit in the Chapel Hill quadrangle.

REFERENCES

Allen, E.P., and Wilson, W.F., 1968, Geology and mineral resources of Orange County, North Carolina: Division of Mineral Resources, North Carolina Department of Conservation and Development, Bulletin 81, 58 p.

Bradley, P.J., Gay, N.K., and Bechtel, R., 2006, Geologic map of the Efland 7.5-minute quadrangle, Orange County, North Carolina: North Carolina Geological Survey Open-file Report 2006-02, scale 1:24,000, in color.

Bradley, P.J. and Miller, B.V., 2011, New geologic mapping and age constraints in the Hyco Arc of the Carolina terrane in Orange County, North Carolina: Geological Society of America Abstracts with Programs, Vol. 43, No. 2.

Fisher, R.V. and Schmincke H.-U., 1984, Pyroclastic rocks, Berlin, West Germany, Springer-Verlag, 472 p.

Glover, L., and Sinha, A., 1973, The Virgilina deformation, a late Precambrian to Early Cambrian (?) orogenic event in the central Piedmont of Virginia and North Carolina, American Journal of Science, Cooper v. 273-A, pp. 234-251.

Hanna, H.D., Bradley, P.J., and Gay, N.K., 2010, Geologic map of the Cedar Grove 7.5-minute quadrangle, Orange, Person and Caswell Counties, North Carolina: North Carolina Geological Survey Open-file Report 2010-02, scale 1:24,000, in color.

Hanna, H.D. and Bradley, P.J., 2011, Geologic map of the Orange County and adjacent portions of the Burlington NE 7.5-minute quadrangle, Orange, Alamance and Caswell Counties, North Carolina: North Carolina Geological Survey Open-file Report 2011-05, scale 1:24,000, in color.

Harris, C., and Glover, L., 1985, The Virgilina deformation: implications of stratigraphic correlation in the Carolina slate belt, Carolina Geological Society field trip guidebook, 36 p.

Harris, C., and Glover, 1988, The regional extent of the ca. 600 Ma Virgilina deformation: implications of stratigraphic correlation in the Carolina terrane, Geological Society of America Bulletin, v. 100, pp. 200-217.

Hibbard, J., Samson, S., 1995, Orogenesis exotic to the Iapetan cycle in the southern Appalachians, In, Hibbard, J., van Staal, C., Cawood, P. editors, Current Perspectives in the Appalachian– Caledonian Orogen. Geological Association of Canada Special Paper, v. 41, pp. 191–205.

Le Maitre, R.W., Ed., 2002, Igneous Rocks: A Classification and Glossary of Terms: Recommendations of the International Union of Geological Sciences (IUGS) Subcommission on the Systematics of Igneous Rocks: Cambridge, Cambridge University Press, 252 p.

Pollock, J. C., 2007, The Neoproterozoic-Early Paleozoic tectonic evolution of the peri-Gondwanan margin of the Appalachian orogen: an integrated geochronological, geochemical and isotopic study from North Carolina and Newfoundland. Unpublished PhD dissertation, North Carolina State University, 194 p.

Tadlock, K.A. and Loewy, S.L., 2006, Isotopic characterization of the Farrington pluton: constraining the Virgilina orogeny, in Bradley, P.J., and Clark, T.W., editors, The Geology of the Chapel Hill, Hillsborough and Efland 7.5-minute Quadrangles, Orange and Durham Counties, Carolina Terrane, North Carolina, Carolina Geological Society Field Trip Guidebook for the 2006 annual meeting, pp. 17-21.

Wilson, W.F. 1975, Geology of the Winstead 15-minute quadrangle, North Carolina. Geological Map Series 2, North Carolina Geological Survey.

Wortman, G.L., Samson, S.D., and Hibbard, J.P., 2000, Precise U-Pb zircon constraints on the earliest magmatic history of the Carolina terrane, Journal of Geology, v. 108, pp. 321-338.

Geologic Map of the Orange County and Adjacent Portions of the Mebane 7.5-Minute Quadrangle, Orange and Alamance Counties, North Carolina

By
Philip J. Bradley

Geologic data collected in Spring 2010 through Summer 2010. Map preparation, digital cartography and editing by Michael A. Medina, Heather D. Hanna and Philip J. Bradley.
2011