# UPDATE ON 1:24,000 GEOLOGIC MAPPING OF THE BREVARD ZONE AND RELATED STRUCTURES IN EAST-CENTRAL ALABAMA



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### **ABSTRACT**

The Brevard zone (BZ) is an enigmatic polyphase Paleozoic shear zone in the southern Appalachians that serves as, at least in part, the boundary between the eastern Blue Ridge (EBR) and the Inner Piedmont (IP) terranes. In east-central Alabama, the BZ is lithologically defined by the Jacksons Gap Group (JGG), a distinctive group of relatively low-grade and locally weakly strained metasiliciclastic and metapelitic rocks structurally bounded between the Abanda (northwest) and Katy Creek faults (southwest), occurring between the Emuckfaw Group (EG) of the EBR and Dadeville Complex (DC) of the IP. Recent detailed geologic mapping at 1:24,000 scale, in conjunction with geochronologic, geochemical, lithotectonic, and structural data provide new insights into the nature and significance of this regional geologic feature. We present a compilation of detailed geologic maps tracing the limbs of the late-stage Tallassee synform in Alabama and report field, structural, petrographic, and isotopic data related to the development of the BZ and its associated structures. Major findings include: (1) locally the JGG is a distinctly lower grade (greenschist-facies) and lower strained package of metasedimentary rocks than the bounding EG and DC (both amphibolite-facies); (2) recent geological mapping in the Roanoke East, Alabama, quadrangle has revealed the presence of an igneous intrusion within the JGG that we correlate to the Long Island Creek Gneiss in neighboring Georgia, which has implications for the relationship between the EG and JGG; (3) the detrital zircon age spectra of some rocks from the EBR, JGG, and Opelika Complex (OC) are similar to those of the western Blue Ridge in the foreland and are thus interpreted to be earliest Laurentian margin drift facies; (4) the DC is a Late Cambrian- to Early Ordovician-aged exotic volcanic arc complex cradled between Laurentian units of the EBR (e.g., the JGG and OC) and Pine Mountain Window (PMW); (5) the Stonewall line fault juxtaposes the DC and OC in the southeast and likely corresponds, at least in part, to the Katy Creek fault in the northwest; (6) the early Paleozoic Alabama-Georgia Laurentian margin may have originated as an embayment with marginal EBR strata to the west and PMW basement/cover rocks to the east, a shape roughly corresponding to the regional Tallassee

# **REGIONAL GEOLOGY**

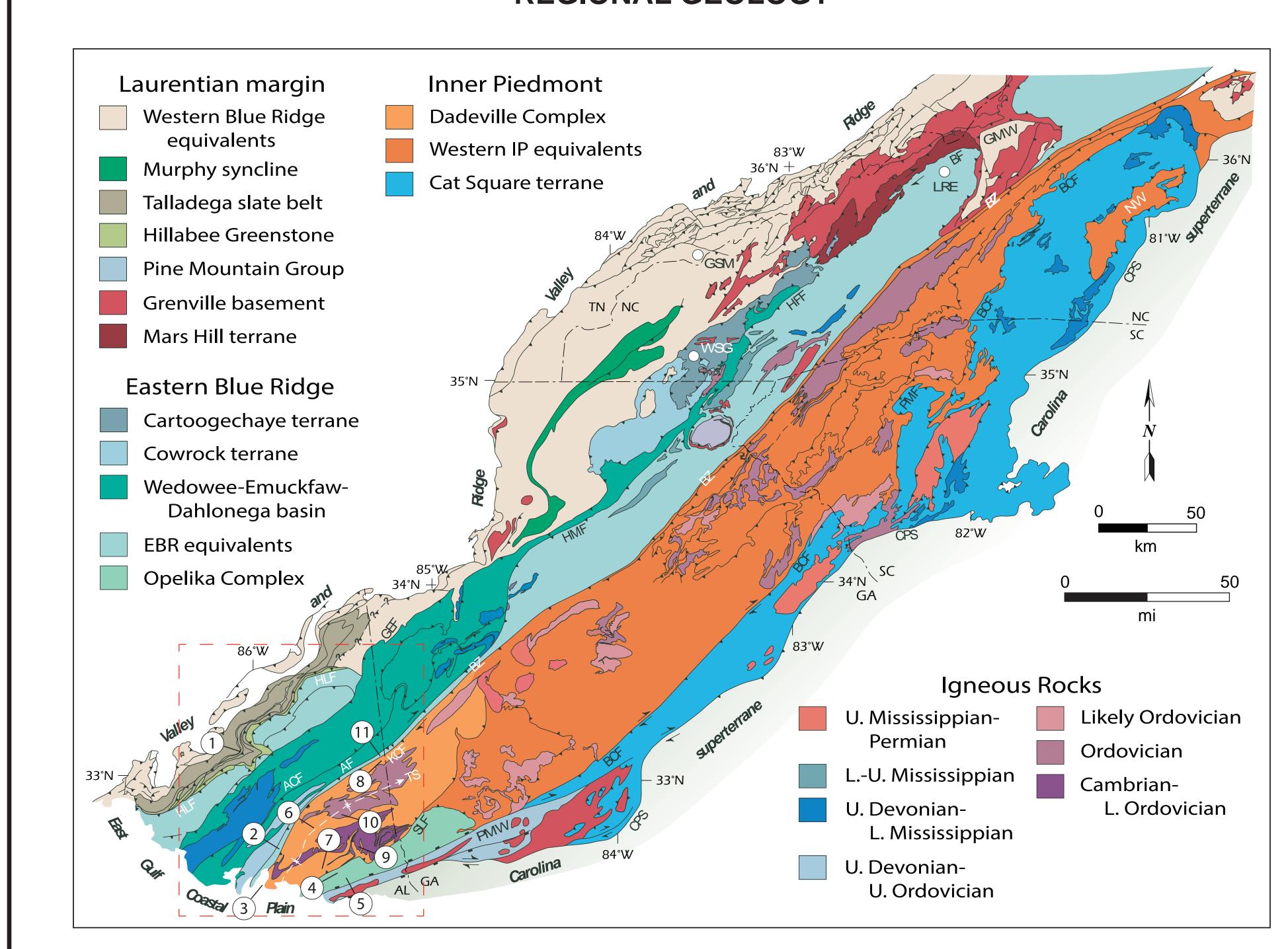
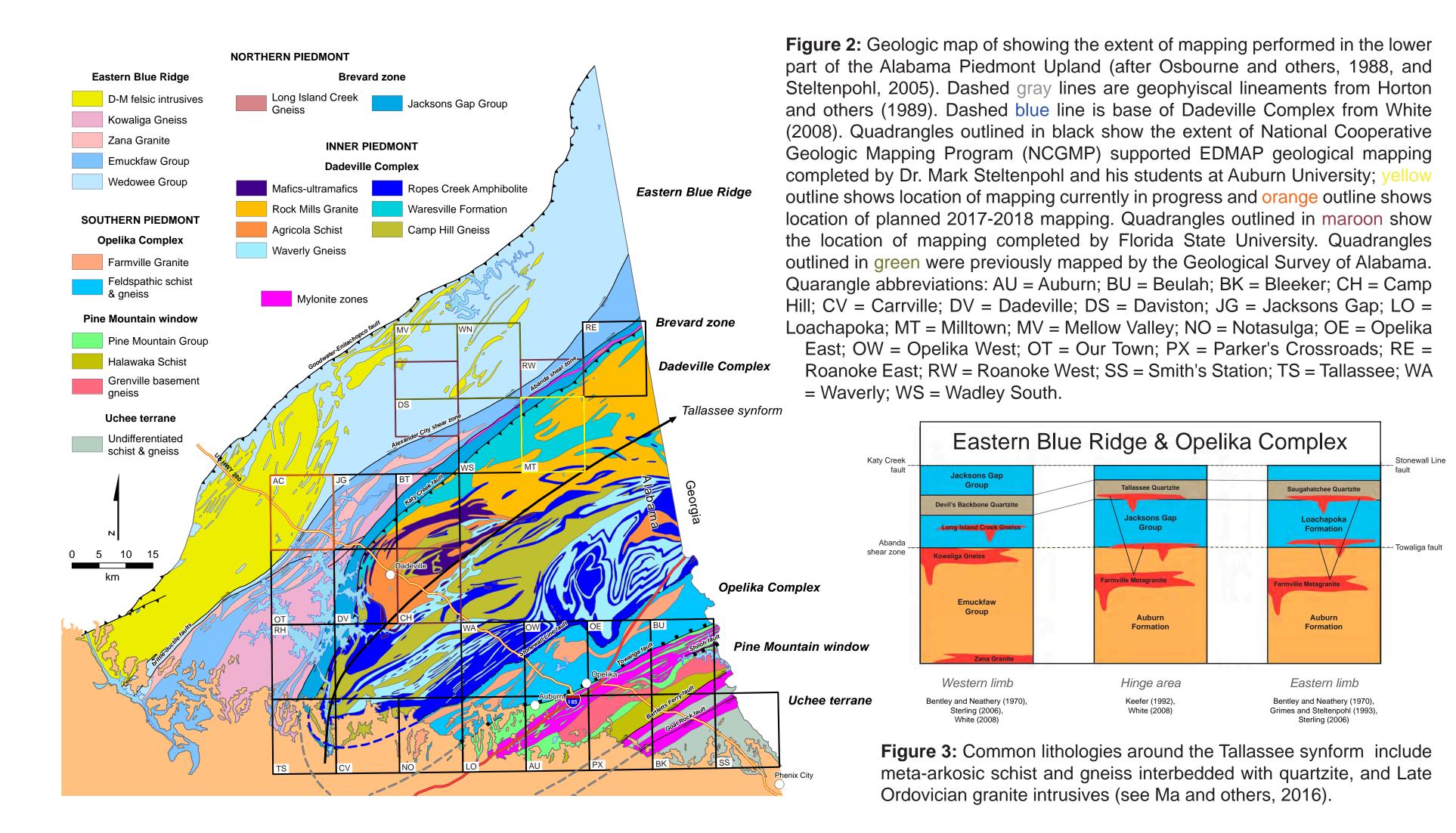
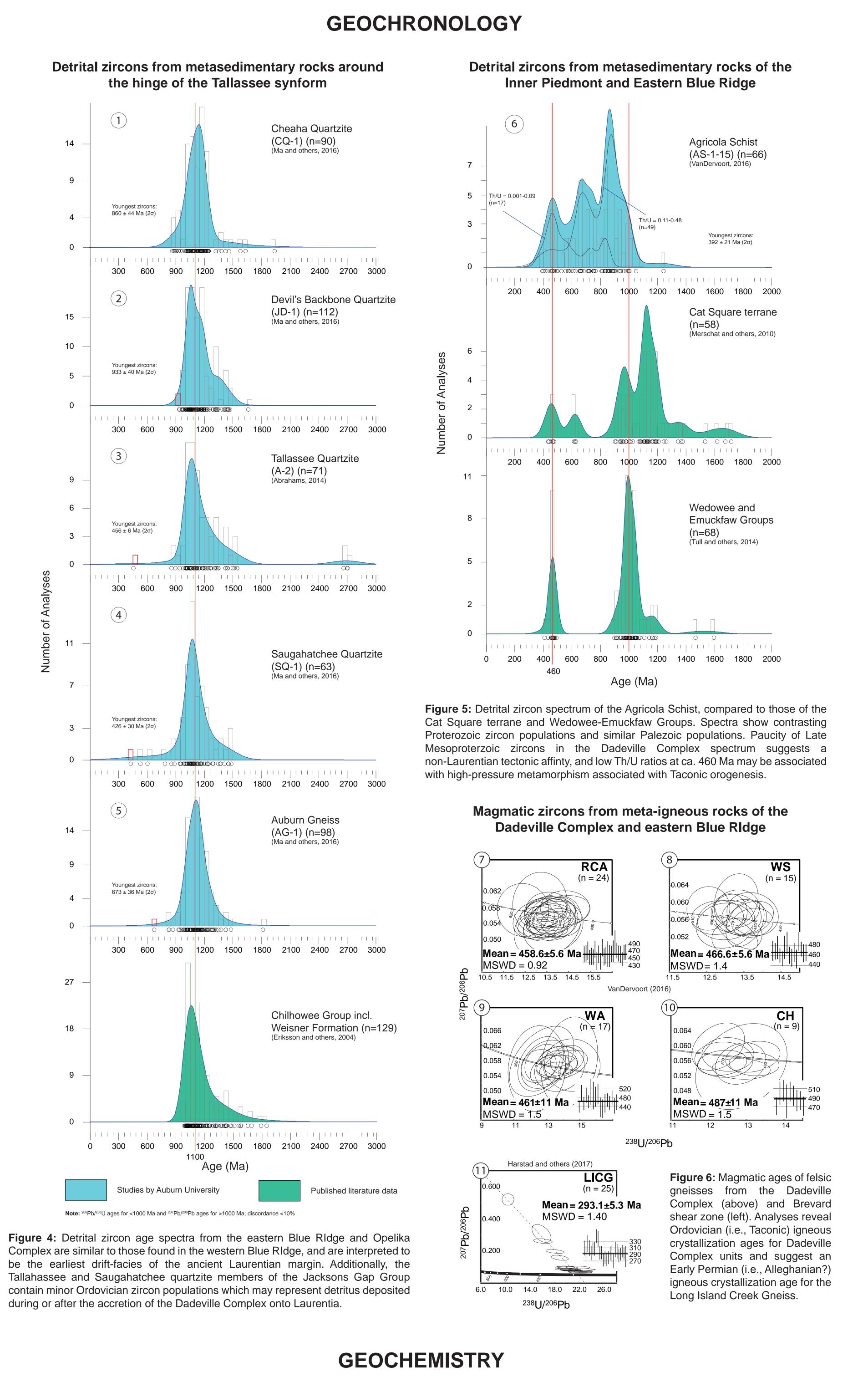
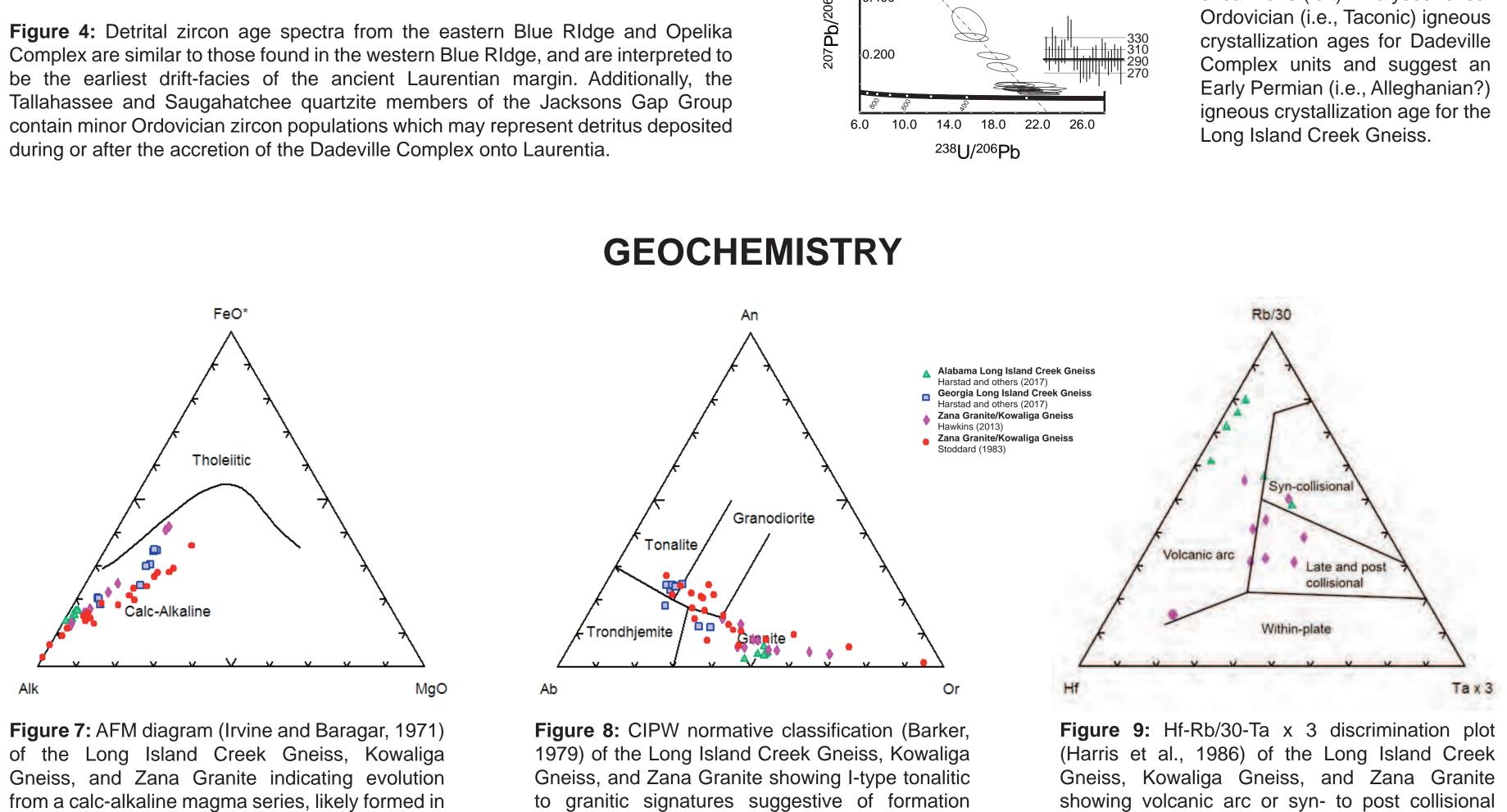


Figure 1: Tectonic map of part of the Blue Ridge and Inner Piedmont of Alabama, Georgia, North Carolina, South Carolina, and Tennessee (modified after Merschat and others, 2010) showing the locations of detrital and magmatic zircon samples analyzed by workers and students at Auburn University (e.g., Abrahams, 2014; VanDervoort, 2016; Ma and others, 2016). Red box denotes the location of figure 2. AF = Abanda fault; ACF = Alexander City fault; BCF = Brindle Creek fault; BF = Burnsville fault; BFZ monzonite; HFF = Hayesville-Fries fault; HLF = Hollins Line fault; HMF = Holland Mountain fault; KCF = Katy Creek fauly; LRE = Lick Ridge eclogite; NW = Newton Window; PMW = Pine Mountain Window; SLF = Stonewall Line fault; TS = Tallassee synform (plunge = 0-20°); WSG = Winding Stair Gap granulite.

# PIEDMONT GEOLOGY





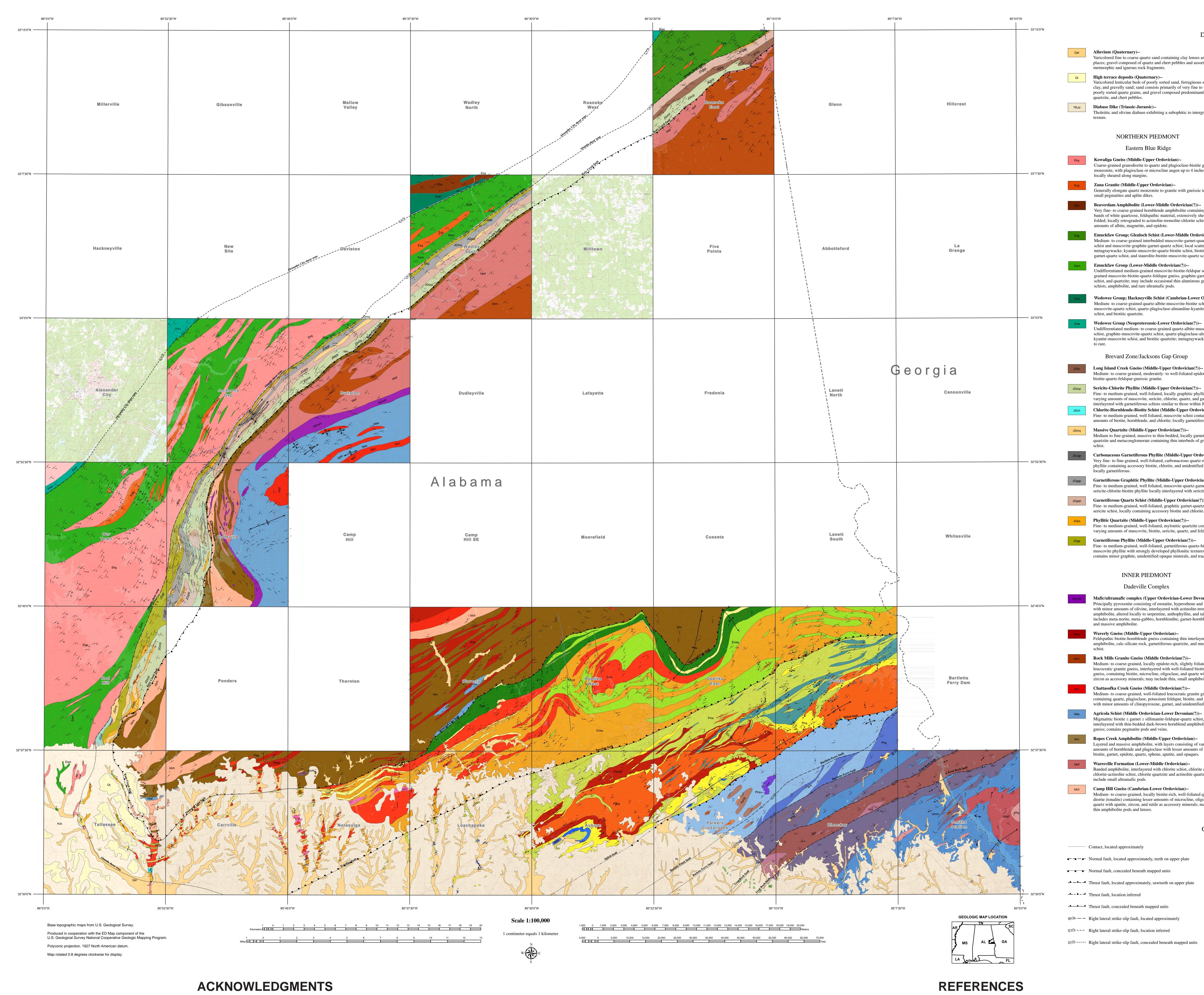


teconic geochemical signatures.

within an evolving volcanic arc.

Tholeiitic

an evolving volcanic arc.



quartzite containing muscovite, feldspar, garnet, and sillimanite Loachapoka Schist (Neoproterozoic-Silurian(?))-muscovite schist, minor quartzite, and minor amphibolite; locally contains

Auburn Gneiss (Neoproterozoic-Middle Ordovician(?))--Medium- to coarse-grained biotite-oligoclase gneiss (quartz-diorite). nterbedded with very coarse-grained muscovite-biotite schist; locally contains small muscovite-rich pegmatite veins. Auburn Schist and Gneiss (Neoproterozoic-Middle Ordovician(?))--Undifferentiated fine- to coarse-grained biotite-feldspar gneiss, massive

metagraywacke, and biotite schist, interbedded with coarse- to very-coarse grained and locally migmatitic garnetiferous feldspar-muscovite-biotite Pine Mountain Window

dolomitic marble; locally rich in phlogopite along shear planes near the

Phelps Creek Gneiss (Middle-Upper Silurian)-Medium grained quartz monzonite to granite gneiss of Emuckfaw Group; Glenloch Schist (Lower-Middle Ordovician(?))--Medium-grained quartz monzonite to granite gneiss, often strongly foliated and in part cataclastic; occurs in dikes and sheets with wide migmatite zones schist and muscovite-graphite-garnet-quartz schist; local scattered layers of metagraywacke, kyanite-muscovite-quartz-biotite schist, biotite-muscovite-Pgu Unnamed Granitic Intrusive (Middle-Upper Silurian(?))-garnet-quartz schist, and staurolite-biotite-muscovite-quartz schist Fine- to medium-grained leucocratic biotite- and feldspar-rich granitic Emuckfaw Group (Lower-Middle Ordovician(?))--Manchester Gneiss (Neoproterozoic-Lower Cambrian(?))-grained muscovite-biotite-quartz-feldspar gneiss, graphite-garnet-muscovite

NORTHERN PIEDMONT

Eastern Blue Ridge

Zana Granite (Middle-Upper Ordovician)--

amounts of albite, magnetite, and epidote.

small pegmatites and aplite dikes.

oarse-grained granodiorite to quartz and plagioclase-biotite gneiss,

monzonite, with plagioclase or microcline augen up to 4 inches in diameter;

Generally elongate quartz monzonite to granite with gneissic texture, cut by

Very fine- to coarse-grained hornblende amphibolite containing delicate bands of white quartzose, feldspathic material, extensively sheared and

folded; locally retrograded to actinolite-tremolite-chlorite schist with minor

schist, and quartzite; may include occasional thin aluminous graphitic

kyanite-muscovite schist, and biotitic quartzite; metagraywacke are common

feldspathic metaconglomerate and locally granite dikes and pegmatites; schists, amphibolite, and rare ultramafic pods. Wedowee Group; Hackneyville Schist (Cambrian-Lower Ordovician(?))--Manchester Schist (Neoproterozoic-Lower Cambrian(?))-muscovite-quartz schist, quartz-plagioclase-almandine-kyanite-muscovite containing garnet, magnetite, sillimanite, graphite, quartz, and subordinate thin quartz and carbonate lenses; commonly intensely sheared. we Wedowee Group (Neoproterozoic-Lower Ordovician(?)) Chewacla Marble (Neoproterozoic-Lower Cambrian(?))--Indifferentiated medium- to coarse-grained quartz-albite-muscovite-biotite Light-gray to yellowish-gray locally siliceous medium to coarsely crystalline schist, graphite-muscovite-quartz schist, quartz-plagioclase-almandine-

Hollis Quartzite (Neoproterozoic-Lower Cambrian(?))--Brevard Zone/Jacksons Gap Group of muscovite, microcline, and sulfide minerals; may be massive or have numerous interbedded schist laminae. Long Island Creek Gneiss (Middle-Upper Ordovician(?))--Halawaka Gneiss (Neoproterozoic-Lower Cambrian(?))--

Medium- to coarse-grained, moderately- to well-foliated epidote-muscovitebiotite-quartz-feldspar-gneissic granite. Medium- to coarse-grained leucocratic quartz diorite pencil gneiss interlayered with epidote-hornblende-oligiclase gneiss and amphibolite; Sericite-Chlorite Phyllite (Middle-Upper Ordovician(?))--Fine- to medium-grained, well-foliated, locally graphitic phyllite containing varying amounts of muscovite, sericite, chlorite, quartz, and garnet; locally Halawaka Amphibolite (Neoproterozoic-Lower Cambrian(?))-nterlayered with garnetiferous schists similar to those within JGgqs. Fine- to medium-grained intermixed hornblende schist and amphibolite Chlorite-Hornblende-Biotite Schist (Middle-Upper Ordovician(?))-containing varying amounts of hornblende and plagioclase with quartz,

Fine- to medium-grained, well foliated, muscovite schist containing varying diopside, epidote, calcite, titanite, and ilmenite as accessory minerals. amounts of biotite, hornblende, and chlorite; locally garnetiferous. Halawaka Schist (Neoproterozoic-Lower Cambrian(?))--Massive Quartzite (Middle-Upper Ordovician(?))--Medium to fine-grained, massive to thin-bedded, locally garnetiferous feldspar schist, quartzofeldspathic mylonite, orthoquartzite, muscovitequartzite and metaconglomerate containing thin interbeds of graphitic quartz graphite schist, and well-banded (2-3 m thick) schist containing alternating Carbonaceous Garnetiferous Phyllite (Middle-Upper Ordovician(?))-hyllite containing accessory biotite, chlorite, and unidentified opaques;

ootassium feldspar augen of microcline and/or orthoclase accessory minerals include epidote, sphene, zoisite, apatite, zircon, pyrite and magnetite. Garnetiferous Graphitic Phyllite (Middle-Upper Ordovician(?))--Grenville Basement Complex (Mesoproterozoic-Neoproterozoic(?))e- to medium-grained, well foliated, muscovite-quartz-garnet-graphite-Medium- to coarse-grained charnockite, charnockite gneiss, feldspathic and ericite-chlorite-biotite phyllite locally interlayered with sericitic quartzite. migmatitic augen gneiss, mylonitic schist, and minor ultramylonite. Garnetiferous Quartz Schist (Middle-Upper Ordovician(?))--Uchee-Carolina Terrane ne- to medium-grained, well-foliated, graphitic garnet-quartz-muscovitesericite schist, locally containing accessory biotite and chlorite. Mylonite (Late Silurian-Lower Devonian(?))--

Phyllitic Quartzite (Middle-Upper Ordovician(?))--Granitic-to-dioritic mylonite, ultramylonite, and locally cataclasite with Fine- to medium-grained, well-foliated, mylonitic quartite containing lenses of mylonitized amphibolite and hornblende gneiss and rare varying amounts of muscovite, biotite, sericite, quartz, and feldspar. Hornblende Gneiss (Late Silurian-Lower Devonian(?))-Fine- to medium-grained melanocratic banded hornblende gne **Garnetiferous Phyllite (Middle-Upper Ordovician(?))--**Fine- to medium-grained melanocratic banded hornblende gneiss; commonly muscovite phyllite with strongly developed phyllonitic textures; locally contains minor graphite, unidentified opaque minerals, and trace epidote. Standing Boy Quartz Diorite (Late Silurian-Lower Devonian(?))--Fine- to medium-grained leucocratic massive to gneissic quartz diorite interlayered with local biotite schist, feldspathic biotite-hornblende

dioritic gneiss interlayered with local biotite schist, feldspathic biotite-Mafic/ultramafic complex (Upper Ordovician-Lower Devonian(?))hornblende gneiss, thin amphibolite layers, and minor calc-silicates. incipally pyroxenite consisting of enstatite, hypersthene and bronzite, with minor amounts of olivine, interlayered with actinolite-tremolite Biotite Schist (Late Silurian-Lower Devonian(?))-amphibolite, altered locally to serpentine, anthophyllite, and talc; locally Fine- to medium-grained interbedded quartz-plagioclase-biotite phyllonite, includes meta-norite, meta-gabbro, hornblendite, garnet-hornblendite schist, and gneiss; commonly mylonitic. and massive amphibolite. Waverly Gneiss (Middle-Upper Ordovician)--Medium-grained leucocratic quartz diorite pencil gneiss containing local zones of sheared epidote-hornblende-oligoclase amphibolite.

amphibolite, calc-silicate rock, garnetiferous quartzite, and muscovite Moffits Mill Schist (Late Silurian-Lower Devonian(?))--Rock Mills Granite Gneiss (Middle Ordovician(?))--Fine to medium-grained interlayered biotite-epidote-muscovite-quartz schist, metagraywacke, and quartzite; locally migmatitic. Medium- to coarse-grained, locally epidote-rich, slightly foliated leucocratic granite gneiss, interlayered with well-foliated biotite granite gneiss, containing biotite, microcline, oligoclase, and quartz with rutile and con as accessory minerals; may include thin, small amphibolite bodies. EAST GULF COASTAL PLAIN

> sand consisting chiefly of chert and quartz pebbles Tuscaloosa Group; undifferentiated (Cretaceous)--Light-gray to moderate-reddish-orange interbeddeds of clayey, gravely fine to very coarse sand, massive mottled sandy clay, and local thin beds of indurated

Tuscaloosa Group; Gordo Formation (Cretaceous)--

gneiss, and thin amphibolite layers.

Hospilika Granite (Late Silurian-Lower Devonian(?))--

Fine- to medium-grained leucocratic epidote-muscovite granitic to quartz

Tuscaloosa Group; Coker Formation (Cretaceous)--Light-reddish-gray to yellowish-gray cross-bedded, poorly-sorted, micaceous, very fine to medium sand, varicolored micaceous clay, and thin gravel bed containing quartz and chert pebbles; locally quartz and chert gravels at the base of the formation range in size from very fine pebbles to large cobbles.

Cross-bedded sand in massive beds that locally contain gravel and gray,

noderate-red and pale-red-purple partly mottled clay in beds that generally are

lenticular and locally carbonaceous; lower part is predominantly a gravelly

## GEOLOGIC MAP SYMBOLS

■ ■ ■ Normal fault, located approximately, teeth on upper plate •···• Normal fault, concealed beneath mapped units → → → Thrust fault, located approximately, sawteeth on upper plate **→** Doubly plunging synform 

**→** - **→** Thrust fault, location inferred -A---A Thrust fault, concealed beneath mapped unit **=** − − Right lateral strike-slip fault, located approximately Right lateral strike-slip fault, location inferred

Chattasofka Creek Gneiss (Middle Ordovician(?))--

gneiss; contains pegmatite pods and veins.

Waresville Formation (Lower-Middle Ordovician)--

Camp Hill Gneiss (Cambrian-Lower Ordovician)--

include small ultramafic pods.

Medium- to coarse-grained, well-foliated leucocratic granite gneiss

Agricola Schist (Middle Ordovician-Lower Devonian(?))--

Ropes Creek Amphibolite (Middle-Upper Ordovician)--

biotite, garnet, epidote, quartz, sphene, apatite, and opaques.

igmatitic biotite ± garnet ± sillimanite-feldspar-quartz schist,

interlayered with thin-bedded dark-brown hornblend amphibolite and

vered and massive amphibolite, with layers consisting of varying

amounts of hornblende and plagioclase with lesser amounts of augite,

hlorite-actinolite schist, chlorite quartzite and actinolite quartzite; may

diorite (tonalite) containing lesser amounts of microcline, oligoclase and quartz with apatite, zircon, and rutile as accessory minerals; may contain

Medium- to coarse-grained, locally biotite-rich, well-foliated quartz

ontaining quartz, plagioclase, potassium feldspar, biotite, and muscovite,

with minor amounts of clinopyroxene, garnet, and unidentified opaques.

◆ ↑ ↑ ◆ Overturned doubly plunging synform → → Doubly plunging synformal anticline Strike and dip of foliation

Bearing and plunge of extension lineation Bearing and plunge of intersection lineation Bearing and plunge of mineral lineation Bearing and plunge of mylonitic elongation lineation Bearing and plunge of syn-metamorphic fold hinge

Strike and dip of mylonitic foliation

Bearing and plunge of elongation lineation

Bearing and plunge of post-metamorphic fold hinge Bearing and plunge of composite S-C fabric

