U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

Geologic map of the Atlanta 30′ x 60′ quadrangle, Georgia

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Open-File Report 98-245

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DESCRIPTION OF MAP UNITS

Qg

Gossan (Holocene?)—Dark-brown, iron-rich, siliceous, porous-textured, weathering product of massive sulfide body(ies). Found in fault zones in Ropes Creek Metabasalt, in mixed unit of the oceanic assemblage, and in sheared and altered rocks in fault zones, generally near magnetite quartzite

JTRd

Diabase (Early Jurassic to Late Triassic)—Fine- to medium-grained, dark-gray to black augite diabase, locally containing small amounts of olivine, hypersthene, hornblende, magnetite, and pyrite (see Lester and Allen, 1950), in dikes generally 5 to 30 m wide in the Atlanta quadrangle (width exaggerated on map; all dikes are shown at the same thickness). The diabase weathers to a dark-red clayey soil that contains spheroidal boulders with fresh rock inside an armoring, ocherous rind; the weathered rock in the boulders exfoliates like leaves on a head of cabbage

FAULT ROCKS—PROTOLITH UNKNOWN

KPb

Microbreccia (Cretaceous? to Permian?)—Fine-grained, light-gray to white, locally pinkish, generally cherty (flinty)-appearing, silicified microbreccia (flinty crush-rock), composed mainly of potassium feldspar and (or) plagioclase, and quartz. In thin section, most are seen to be multiply brecciated. To the east, in the Athens 30′×60′ quadrangle, large thick bodies of microbreccia have central lenses composed of interlocking quartz crystals as large as 1 to 1.5 cm and outer edges of broken quartz-vein breccias, all suggesting that the microbreccias are late- or post-metamorphic features and implying Pennsylvanian to Permian ages of faulting. Even younger episodes of faulting along the trends of microbreccias are indicated by offset Late Triassic to Early Jurassic diabase dikes in the western part of the Athens 30′×60′ quadrangle (Jones, 1970; M.W. Higgins, T.J. Crawford, and Rebekah Brooks, unpublished geologic map of Athens, Ga., 30′×60′ quadrangle), but displacements may be relatively small

PSm

Mylonitized granitoid (Permian? to Silurian?)—Light-gray to nearly white mylonite and (or) mylonite gneiss derived from granite and (or) granite gneiss. Ductile style of deformation indicates the faulting was synmetamorphic and thus Permian or older

POb

Button schist (Permian? to Upper Ordovician?)—Gray to silvery, tan-weathering (±chlorite)-plagioclase-quartz-sericite button schist (Higgins, 1971) with C-S texture (Berthé and others, 1979); S-C mylonite of Lister and Snoke (1984) with fish-scale texture and locally displaying fish-flash (Simpson, 1986, p. 252); locally manganiferous; in many places including (±chlorite)-sericite-quartz-plagioclase phyllonite with mica-fish and fish-flash, and, locally, lenses and slivers of sheared chlorite-actinolite-(±hornblende)-plagioclase and chlorite-actinolite-plagioclase-hornblende amphibolites. Weathers to a red soil with buttons (mica porphyroclasts, mica-fish) scattered on the ground surface. Probably derived by shearing mostly of mixed unit (OZm)

PObg

Graphitic button schist (Permian? to Upper Ordovician?)—Gray to silvery, tan- to gray-weathering, slightly graphitic fish-scale (±chlorite)-graphite-quartz-sericite button schist with lenses of more graphitic button schist. Protolith indeterminate, possibly graphitic schist/phyllite (O€g) within the Bill Arp Formation or highly sheared Laffingal Member of the Nantahala Formation (€nl), as in the Mulberry Rock structure in the northwestern corner of map

FAULT ROCKS—PROTOLITH KNOWN

PCmb

Mylonitized Ben Hill Granite (Permian? to Carboniferous)—Generally fine-grained, light-gray to white mylonite and mylonite gneiss that contain a few scattered porphyroclasts of potassium feldspar as large as about 1 cm in most outcrops and many porphyroclasts as large as 1.5 cm in some outcrops. Contact with unmylonitized Ben Hill Granite has not been observed but is thought to be within the solid contact line at 1:100,000 scale

JMb

Metatrondhjemite breccia (Jurassic? to Mississippian?)—Light-gray breccia composed of angular fragments of metatrondhjemite as large as 3 cm. Holds up a low ridge

POcm

Mylonitized Chattahoochee Palisades Quartzite (Permian? to Upper Ordovician?)—Gray to greenish-tan, schistose mylonite with abundant thin stringers of mylonitized quartz and local lenses of mylonitized quartz rock as thick as 0.5 m. Locally has buttony S-C mylonite texture but more commonly has schist texture probably due to more laminar mylonitization

POgm

Mylonitized garnet schist (Permian? to Upper Ordovician?)—Buttony, mylonitic garnet-biotite-muscovite-plagioclase-quartz schist with S-C mylonite texture, generally containing small (4 mm or less), pinkish-red garnets that are commonly porphyroclasts and knots and stringers of quartz

POms

Button schist and sheared amphibolite derived by shearing of mixed unit (OZm) (Permian? to Upper Ordovician?)—Gray to silvery, tan-weathering (±chlorite)-quartz-sericite button schist (Higgins, 1971) with C-S texture (Berthé and others, 1979); S-C mylonite of Lister and Snoke (1984) with fish-scale texture and commonly displaying fish-flash (Simpson, 1986, p. 252), with lenses and slivers of chlorite-actinolite-(±hornblende)-plagioclase and sheared chlorite-actinolite-plagioclase-hornblende amphibolites. Locally containing fine-grained, blocky and sooty weathering (±magnetite)-spessartine quartzite (gondite, coticule rock) (OZmm) in beds about 0.3 to 1 m thick indicating that the protolith was the allochthonous assemblage mixed unit (OZm)

SHEARED AND ALTERED ROCKS IN FAULT ZONES

POm

Tectonically mixed unit (Permian? to Upper Ordovician?)—Tectonic mixture of amphibolite of Ropes Creek Metabasalt (OZr), sheared and schistose biotite gneiss of Stonewall Gneiss (OZs), and quartzose garnetiferous schist of Crawfish Creek Formation (€cf) in braided fault slices that could not be separately mapped at 1:12,000 scale

POs

Sheared and altered fault rocks in fault zones (Permian? to Upper Ordovician?)—Generally fine-grained, red to white, commonly slightly graphitic, locally garnetiferous, chlorite-sericite schist commonly with button texture and tan to white, platy, siliceous rocks, locally with radiating clusters of actinolite on S-planes. Locally has trace amounts of magnetite, sulfide minerals, and, rarely, fuchsite. Commonly contains magnetite quartzites and, locally, massive sulfide deposits

POpa

Rocks of the Pine Mountain alteration zone (Permian? to Upper Ordovician?)—Light-gray to greenish-white, epidote-rich granofels and light-green to epidote-green, epidote-rich, chlorite-rich amphibolites that resemble Paulding Volcanic-Plutonic Complex but are less chaotic

POag **Garnet Hill type altered rocks (Permian? to Upper Ordovician?)**—Named for Garnet Hill in the south-central part of the Dallas 7.5-min quadrangle where they can be seen along the road that crosses the hill and along the north-south road just west of the hill, especially where that road crosses Mill Creek. They are pervasively sheared, buttony, coarse-grained, well-foliated, green, greenish- to reddish-weathering, actinolite-chlorite schist and slightly graphitic to graphitic button schists that generally contain abundant euhedral garnets as large as 2 to 4 cm, but commonly less than 1 cm, and locally contain radiating clusters of actinolite on S-planes (generally on S-planes parallel to wavy shear-planes). Thin layers of chlorite-quartz-sericite schist, generally with small euhedral magnetite crystals, are intercalated with the actinolite-chlorite schist. Large garnets are commonly flattened and (or) sheared euhedra that can be flaked apart; subhedral garnets are commonly sheathed in wavy chlorite bundles. In many outcrops garnets are conspicuously elongated. Locally there are layers and lenses of light-colored, greatly leached, chalky-weathering, pyritiferous, euhedral magnetite crystal-bearing platy quartzite and (or) felsite and highly pyritiferous quartz rocks. The unit contains gossan, ferrous quartzites, and massive sulfide deposits

POc **Chlorite schist (Permian? to Upper Ordovician?)**—Green, generally contorted, (±garnet)-quartz-plagioclase-actinolite-chlorite schist derived from shearing and alteration of amphibolite along fault(s)

POuc **Serpentine schist (Permian? to Upper Ordovician?)**—Green to light-green, generally contorted, chlorite-actinolite-serpentine schist derived from shearing and alteration of ultramafic rock along fault(s)

POsb **Silicified schist and metagraywacke (Permian? to Upper Ordovician?)**—Garnet-biotite-muscovite-plagioclase-quartz schist and (±garnet)-biotite-plagioclase-quartz metagraywacke derived from silicification and thermal alteration of Bill Arp Formation phyllite and metagraywacke adjacent to fault(s)

PYl **Long Island Creek Gneiss (Permian? to Middle Proterozoic?)**—Light- to dark-gray, well-layered (layers generally about 8 to 40 cm thick), medium-grained, generally blastomylonitic epidote-biotite-plagioclase-quartz gneiss, with tiny crystals of sphene, interlayered with biotite-epidote-muscovite-quartz-plagioclase-microcline gneiss; microcline content quite variable. Mylonite gneiss with porphyroclasts of potassium feldspar in many outcrops. Locally forms pavement outcrops. Characteristically cut by numerous 6- to 20-cm-thick quartz veins and sills and aplite dikes and sills. Weathers to a characteristic yellowish soil

SYg **Gothards Creek Gneiss (Lower Silurian? to Middle Proterozoic?)**—Light-gray, medium- to coarse-grained, pervasively sheared, schistose and finely layered biotite-quartz-potassium feldspar-plagioclase gneiss that is generally rich in biotite and weathers to a uniform, almost featureless, light-orange saprolite. Age assignment is based on appearance and structural/stratigraphic position (see section on Early Silurian Austell Gneiss), which suggest the possibility that the Gothards Creek could belong with the southern Appalachian basement

GRANITES AND ORTHOGNEISSES

Cs

Stone Mountain Granite (Carboniferous?)—Very homogeneous, fine- to medium-grained, mostly equigranular, whitish-gray, unfoliated biotite-muscovite-microcline-oligoclase-quartz "granite" (quartz monzonite or adamellite) that tends to form pavement outcrops, and weathers to a yellowish, sandy soil in the area around and including Stone Mountain, the type locality, famous landmark, site of Civil War memorial carving, and a prominent nearly unjointed, exfoliating monolithic monadnock that stands over 215 m above the surrounding Piedmont; although flat rock outcrops occur away from that area, they are less common and Stone Mountain Granite tends to form rotten boulders inside granite saprolite and finally weathers to a yellowish, sandy soil. Stone Mountain Granite characteristically has black tourmaline clusters ("cat's paws") a few centimeters in diameter; these can be easily seen in the old curbstone quarry on the eastern side of Stone Mountain and with more difficulty can be found in recent spalls and small quarries on the mountain and in roadcuts and natural outcrops away from the mountain. Xenoliths in Stone Mountain Granite have been interpreted to indicate that the magma intruded in several pulses (Grant and others, 1980) to form a stack of laccoliths. Stone Mountain Granite was extensively quarried for curbstone, building stone, and monumental stone prior to the 1960's

Cu

Union City Granite (Carboniferous?)—Massive, poorly foliated to unfoliated, light-gray, porphyritic, muscovite-biotite-quartz-plagioclase-microcline granite, in which blocky, commonly zoned, microcline phenocrysts, locally as much as 5 cm long, but more commonly 1 to 2.5 cm long, make up 10 to 70 percent, but most commonly 25 to 40 percent, of the rock. Tends to form pavement outcrops and large pedestal-boulder outcrops. Weathers initially to a tan-yellow saprolite with weathered microcline phenocrysts and quartz grains and finally to a light-red soil with quartz grains. Easternmost outcrops are less porphyritic, more foliated, and slightly finer grained. Porphyritic parts are lithologically similar to the Ben Hill and Palmetto Granites in most outcrops; nonporphyritic parts may be Lithonia Gneiss (Dl) between sills of porphyritic granite

Cb

Ben Hill Granite (Carboniferous)—Massive, poorly foliated to unfoliated, light-gray, porphyritic, muscovite-biotite-quartz-plagioclase-microcline granite, in which blocky, commonly zoned, microcline phenocrysts, locally as much as 5 cm long, make up 10 to 70 percent, but most commonly 25 to 40 percent, of the rock. Tends to form pavement outcrops and large pedestal-boulder outcrops (as at Utoy Boulder Park and along Shiprock Road in southwest Atlanta). Weathers initially to a tan-yellow saprolite with weathered microcline phenocrysts and quartz grains and finally to a light-red soil with quartz grains. Lithologically identical to Palmetto Granite (Cp). Higgins and Atkins (1981) interpreted the Ben Hill and Palmetto Granites to be two cupolas on a batholith, but construction of cross sections for this map, using down-plunge projections that show deeper structural levels to the southwest, indicate that the two granite bodies are at different structural levels and are not part of the same batholith, unless they were detached from one another during faulting

Cp	**Palmetto Granite (Carboniferous)**—Massive, poorly foliated to unfoliated, light-gray, porphyritic, muscovite-biotite-quartz-plagioclase-microcline granite, in which blocky, commonly zoned, microcline phenocrysts, locally as much as 5 cm long, make up 10 to 70 percent, but most commonly 25 to 40 percent, of the rock. Tends to form pavement outcrops and large pedestal-boulder outcrops. Weathers initially to a tan-yellow saprolite with weathered microcline phenocrysts and quartz grains and finally to a light-red soil with quartz grains. Lithologically identical to Ben Hill Granite
Cpg	**Porphyritic granite (Carboniferous)**—Porphyritic granite resembling Palmetto and Ben Hill Granites, but not assignable to either granite because the Ben Hill and Palmetto Granites are identical in the field
Cpa	**Panola Granite (Carboniferous)**—Homogeneous, medium-grained, rarely and very poorly foliated (igneous foliation?) to commonly unfoliated, equigranular, dark-gray biotite-oligoclase-quartz-microcline granite. Tends to form pavement outcrops and weathers to a dark-red clayey soil
Dl	**Lithonia Gneiss (Devonian)**—Lithonia Gneiss is a complex of metagranites and granitic gneisses. The most common rock type is a light-gray to grayish-white, medium-grained, poorly foliated, metagranite that is cut by numerous pegmatite and aplite dikes and sills of several generations; dikes of different generations crosscut older dikes. This rock type probably forms about 80 to 90 percent of all rocks mapped as Lithonia Gneiss in the Athens quadrangle, whereas in the Atlanta and Griffin quadrangles it may form only about 40 to 50 percent. The remainder of rocks mapped as Lithonia Gneiss are migmatite gneiss that belong to the Mount Arabia Migmatite of Grant and others (1980; also see Covert, 1986, and Size and Khairallah, 1989), which is included in undivided Lithonia Gneiss (Dl) in this map. The Mount Arabia Migmatite of Grant and others (1980) is a light-gray to whitish-gray, medium-grained muscovite-biotite-microcline-oligoclase-quartz gneiss with well-defined, contorted, generally 3-mm- to 1-cm-thick gneissic layering. The migmatite gneiss is the prevalent rock type in Lithonia Gneiss near its edges, whereas the metagranite is far more prevalent away from the edges of most outcrop areas of Lithonia Gneiss. Garnet segregations in lenses as large as 2 m by 2 m are locally present in the migmatite gneiss. Scattered xenoliths, mainly of amphibolite, are present in the metagranite and the migmatite gneiss, but are probably more abundant in the migmatite gneiss. Pavement outcrops are characteristic of both the metagranite and the migmatite gneiss, and where deeply weathered both form light-whitish-yellow sandy soils. Both the metagranite and the migmatite gneiss are extensively quarried for crushed-stone aggregate and curbstone, and the migmatite gneiss is extensively quarried for monumental stone
Dla	Lithonia Gneiss with amphibolite—This facies of the Lithonia has more abundant amphibolite xenoliths than undivided Lithonia Gneiss
Dlaa	Hornblende-plagioclase amphibolite bodies that are identical to Ropes Creek Metabasalt, but apparently lack magnetite quartzite. Probably large xenoliths and (or) roof pendants
Pzgn	**Unnamed granitic gneiss (Paleozoic)**—Medium- to coarse-grained, light-gray to whitish-gray, muscovite-biotite-potassium feldspar (generally microcline)-quartz-plagioclase (generally oligoclase) gneiss with xenoliths of amphibolite ranging from less than one meter to hundreds of meters long. Locally forms pavement outcrops. Weathers to orange-pink clayey soil. Some gneiss locally has microcline megacrysts as large as 3 cm. Probably belongs with Lithonia Gneiss

Sa

Austell Gneiss (Early Silurian)—Medium- to coarse-grained, light- to medium-gray, well-foliated, biotite-(±muscovite)-oligoclase-quartz-microcline quartz monzonite gneiss with megacrysts of microcline that make up 20 to 50 percent, but commonly 25 to 30 percent, of the rock. Accessories are garnet, ilmenite, sphene, tourmaline, magnetite, allanite, apatite, and zircon in general order of abundance. Microcline megacrysts, as long as 4 cm, but more commonly 1 to 2 mm, and biotite define the foliation, which is an f_e foliation modified by f_{en} folding associated with dextral slip on the Chattahoochee fault at the northwestern edge of the Brevard fault zone. Near its contacts the gneiss is mylonitized in many exposures and the feldspar megacrysts are augen. Forms extensive pavement outcrops and weathers to a yellowish, sandy soil. Early Silurian age based on nearly concordant Pb-Th-U age on zircon of 430 Ma and 5 point Rb-Sr isochron of 432±8 Ma with initial $^{87}Sr/^{86}Sr$ ratio of 0.7073±.0005 to give interpreted age of about 430 Ma (Higgins and others, in press). Extensively quarried for crushed stone

GRANITE/COUNTRY ROCK MIXED UNITS

Granite/country rock mixed units (ages vary)—Units in which fibrous sillimanite has grown across foliation in pelitic country rocks and numerous small sills and dikes of granitic and "sweat-out" pegmatite material make up 40 to 60 percent of most outcrops. Age of mixed unit varies according to the age of the country rock and the age of the pluton

Cb/OZs — Ben Hill Granite intruding Stonewall Gneiss

Cb/OZsl — Ben Hill Granite intruding slabby Stonewall Gneiss

Cp/OZs — Palmetto Granite intruding Stonewall Gneiss

Cp/OZcl — Palmetto Granite intruding Clarkston Formation

Cp/OZw — Palmetto Granite intruding Wahoo Creek Formation

PARAUTOCHTHONOUS LAURENTIAN CONTINENTAL MARGIN ASSEMBLAGE

Northwest of Emerson Fault

Mf

Fort Payne Chert (Lower Mississippian, Osagean)—Light- to medium-gray, locally vitreous, bedded silty and clayey chert interbedded with fissile, argillaceous siltstone and fine-grained sandstone. Near the Emerson fault the Fort Payne consists of breccias made up of angular fragments of recrystallized chert and siltstone cemented together by silica and iron oxides. Contains a shelly fauna of Early Mississippian (Osagean) age (Cressler, 1970). In the Atlanta quadrangle the Fort Payne rests unconformably upon the Middle Ordovician Rockmart Slate (Or). The brittle deformation of the Fort Payne Chert must have occurred after Early Mississippian time

Or

Rockmart Slate (Middle Ordovician)—Dark-gray to nearly black, fine-grained, generally calcareous clay slate that weathers to tan or yellowish-brown. About 90 m thick. Contains Middle Ordovician graptolites (Cressler, 1970; Bergström, 1973; Higgins and others, 1988), Zone 9-10 of Berry (1960). Mined for light-weight aggregate production about 7 km northwest of Yorkville, in the Rockmart area, Cartersville 30 ′×60′ quadrangle

Southeast of Emerson Fault

Cover Sequence

O€b

Bill Arp Formation (Lower Ordovician? to Cambrian)—In the Austell-Frolona anticlinorium the Bill Arp consists of dark-brown to dark-gray, medium-grained, locally feldspathic, generally slightly calcareous, biotite-metagraywacke beds, about 0.3 to 3 m thick, interbedded with fine- to medium-grained, locally slightly graphitic, biotite-muscovite phyllite/schist rarely containing widely scattered, small pink garnets and, locally, small "cross-biotite" crystals. Fine-grained disseminated ilmenite and magnetite are common and characteristic and vein quartz characteristically contains platy ilmenite as large as 5 cm. In streams the metagraywacke beds stand as riffles separated by troughs where pelite beds have weathered out; this can be seen in the Dog River southwest of Bill Arp. In the Mulberry Rock structure and between the Mulberry Rock structure and the Emerson fault the Bill Arp consists of fine-grained metagraywacke units and chlorite-sericite phyllite units of about the same thickness; scattered blue quartz granules and rounded subhedral microcline grains are found in the metagraywackes and are interpreted to indicate a Middle(?) to Late Proterozoic Corbin Metagranite (ZYc) basement source

O€bc

A northeast-trending zone of Bill Arp Formation rocks in the Austell-Frolona anticlinorium in which small pink garnets are scattered in phyllites

O€bb

Zone of Bill Arp Formation rocks in which the garnets are common and larger than in O€bc. In these garnet-bearing zones the pelites are generally schists rather than phyllites and are generally slightly graphitic. Where garnets are common the titanium mineral is rutile instead of ilmenite. Smoky quartz is commonly found where the schists contain relatively common small garnets

O€ba

A zone of Bill Arp Formation rocks with large and abundant garnets has been mapped south of the intersection of Georgia Highway 5 and Interstate 20. Locally the massive metagraywackes in the Bill Arp contain ellipsoidal, zoned calcareous concretions (Sanders and others, 1979) and these calcareous zones are also within the garnet-bearing area as are rocks with "cross-biotite." Graded bedding is common and well preserved in the metapelite-metagraywacke sequences, with facing generally determinable by sharp bottoms and diffuse tops of metagraywacke beds. Along inpaved roads the most common cuts consist of pelite beds separated by quartz-bearing clay-saprolite derived from weathering of the metagraywacke beds

O€bh

Informal schist of Hulett facies—Tan-weathering, finely schistose (±garnet)-biotite-plagioclase-muscovite-quartz schist that contains abundant small red garnets in many outcrops and no garnets in others. The schist generally contains at least two schistosities and original layering has been transposed; the finely spaced schistosity, though a secondary feature, is characteristic. May be equivalent with garnetiferous Bill Arp rocks (O€bc, O€bb, O€ba)

€i

Illinois Creek Formation (Cambrian)—Composed of interlayered, dark-gray, slightly graphitic to moderately graphitic metapelites (phyllite/schist); tan to cream-colored, nongraphitic metapelites (phyllite/schist); and lenses of fine- to coarse-grained, quartz- and feldspar-pebble/granule metaconglomerate that contain blue quartz and microcline granules/pebbles indicative of a Corbin Metagranite source (McConnell and Costello, 1980; Crawford and others, in press)

€sw

Sweetwater Creek Formation (Cambrian)—Composed of interlayered, dark-gray, slightly graphitic to moderately graphitic metapelites (phyllite/schist); tan to cream-colored, nongraphitic metapelites (phyllite/schist); gray to brownish-gray, fine- to medium-grained metagraywackes and feldspathic metagraywackes; and lenses of medium- to coarse-grained quartz- and feldspar-pebble/granule metaconglomerate that contain blue quartz and microcline granules/pebbles indicative of a Corbin Metagranite source and chips of graphitic phyllite/schist suggesting that the underlying Nantahala Formation supplied detritus to the metaconglomerates (McConnell and Costello, 1980; McConnell and Abrams, 1984; Crawford and others, in press)

€swi

Sweetwater Creek and Illinois Creek Formations, undivided

O€g

Graphitic phyllite (between Emerson fault and Mulberry Rock structure) (Middle Ordovician to Cambrian)—Dark-gray to black, fine-grained graphitic phyllite and (or) schist, generally sheared. Locally contains small, pink-red garnets. Locally contains small pyrite cubes. May be thin fault slices of Nantahala Formation (more likely) or thin layers of graphitic phyllite in the Bill Arp Formation. See text section on Mulberry Rock structure for discussion of assignment

Chilhowee Group

€n

Nantahala Formation (Cambrian)—Dark-gray to black, fine-grained, graphitic metapelite (slate/phyllite/schist) rhythmically interbedded with fine-grained, dark-brown, iron-rich metasiltstone, and locally containing lenses of blue-quartz- and potassium feldspar-granule- and, rarely, pebble-metaconglomerate. Schist contains small, pink-red garnets in many outcrops, and in higher grade rocks both schist and metasiltstone contain staurolite crystals. Slate, phyllite, and schist locally contain small pyrite cubes. Has button texture (Higgins, 1971; C-S texture of Berthé and others, 1979; S-C mylonite texture of Lister and Snoke, 1984) in some outcrops. Assigned to Nantahala Formation based on physical continuity of identical rocks in the adjacent Cartersville 30 ′×60′ quadrangle with those of the type locality along the Nantahala River in North Carolina

€nl

Laffingal Member—Dark-gray to black, fine-grained, very graphitic phyllite and (or) schist locally interlaminated with quartzose and feldspathic phyllite and locally containing lenses of blue-quartz- and potassium feldspar-granule- and, rarely, pebble-metaconglomerate. Locally contains lenses of fairly clean quartzite. Locally contains small, pink-red garnets. Locally contains small pyrite cubes. Has button texture (Higgins, 1971; C-S texture of Berthé and others, 1979; S-C mylonite of Lister and Snoke, 1984) in many outcrops. In higher grade rocks in Austell-Frolona anticlinorium window and Crawfish Creek structure graphitic schist locally contains small blue kyanite crystals

€cf

Crawfish Creek Formation (Cambrian and Cambrian?)—Garnet-muscovite-biotite-plagioclase-quartz schist with abundant quartz stringers and pods and containing relatively abundant medium-sized (~0.5 mm to ~1 cm, but locally larger) garnets. Generally contains lenses and layers of clean quartzite as thick as several meters, but more commonly less than 2 m thick

€cq

Clean quartzite units that are locally mappable within the Crawfish Creek Formation

Sandy Springs Group

€cp

Chattahoochee Palisades Quartzite (Cambrian?)—White to yellowish, sugary to vitreous, slightly graphitic to nongraphitic quartzite with accessory muscovite, garnet (generally flattened and elongated), and aluminosilicate minerals, in layers and beds about 0.3 to 1.2 m thick, interbedded with feldspathic quartzite and garnetiferous quartz-muscovite schist. Commonly adjacent to and gradational into the aluminous schist unit (€as). Chattahoochee Palisades Quartzite holds up low ridges that stand 30 to 60 m above intervening valleys and weathers to a quartz-sand saprolite/soil that is locally mineable for quartz sand where the unit is stratigraphically and (or) tectonically thickened. Within the Brevard fault zone, where it was originally named and where the type locality and type section are located (Higgins and McConnell, 1978), the quartzite is generally massive, vitreous, white to bluish, and generally continuous for many kilometers

€as

Aluminous schist unit (Cambrian?)—Consists of light-gray to silvery gray, generally reddish-weathering kyanite or staurolite-garnet-biotite-plagioclase (generally oligoclase)-muscovite-quartz schist, locally with abundant aluminosilicate minerals, locally with abundant garnets. Contains layers of quartz-muscovite schist, thinly layered, red, micaceous quartzite, and lenses of clean quartzite. Commonly contains abundant pegmatites. Commonly found adjacent to Chattahoochee Palisades Quartzite

€aq

Thin (<2 m thick) mappable units of muscovite quartzite that may be fault slices of Chattahoochee Palisades Quartzite (€cp)

Basement

ZYc

Corbin Metagranite of the Allatoona Complex (Late to Middle? Proterozoic)—Light- to dark-gray, medium- to coarse-grained, biotite-quartz-microcline gneiss with microcline megacrysts as large as 8 cm. Tends to form boulder outcrops. Blue quartz is characteristic. Borders of bodies are generally highly sheared in the Atlanta quadrangle and even the centers of the larger bodies are augen gneiss or mylonite gneiss. To the northeast in the Cartersville 30′×60′ quadrangle, the large, massive body containing the type locality contains numerous shear zones where the Corbin is mylonite gneiss or mylonite schist or phyllonite (terminology of Higgins, 1971). Locally the gneiss is so highly sheared that it is transformed into biotite schist. Corbin Metagranite is enriched in zirconium, titanium, light rare earth elements, and especially barium (chemical analyses given in Higgins and others, 1988, appendix B). Dated radiometrically by two methods and by regional relations. See text section on Middle(?) to Late Proterozoic Corbin Metagranite for discussion of age assignment

ALLOCHTHONOUS OCEANIC ASSEMBLAGE

OZp

Paulding Volcanic-Plutonic Complex of the Paulding Allochthon (Middle Ordovician? to Late Proterozoic?)—A chaotic mixture of mafic and felsic rocks marked by an overall meta-igneous, veined, faulted, disrupted, gray to epidote-green appearance. Consists mainly of light-green-weathering, epidote-rich, generally chloritic, green or blue-green hornblende- and (or) actinolite-plagioclase amphibolites (~50–60 percent) intimately interlayered with light-gray to nearly white, amphibole-bearing granofels, biotite-bearing gneisses, and biotite-rich feldspar-rich schist (~20–30 percent). Dikes, sills, and small plutons of potassium feldspar-poor granitic rocks and potassium feldspar-bearing granitic rocks are ubiquitous and numerous (~15–20 percent), and pods of epidosite are common. Thin layers and lenses of vermiculitic mica are also common. Pods of ultramafic rocks are common and in places make up 60 to 80 percent of exposures. At Soapstone Ridge in southeastern Atlanta, pods of ultramafic rocks are so abundant that the unit was once thought to be a mafic-ultramafic sheet (Higgins and others, 1980); areas of high concentrations of residual/colluvial boulders of ultramafic rock are outlined by dashed lines in the Soapstone Ridge outcrop area of Paulding Volcanic-Plutonic Complex. The most common ultramafic rocks are coarse, altered metapyroxenite and soapstone, but altered metadunite, metaperidotite, and serpentinite are also found. Serpentinite (Ozus) is most commonly found adjacent to faults. Silicious "hardpan" is locally found above the rocks. At Soapstone Ridge the most common ultramafic rock is dark-green, coarse- to very coarse grained, highly altered metapyroxenite. The large (4–6 cm) euhedral and subhedral pyroxene crystals are generally completely altered to fibrous meshes of chlorite, talc, tremolite, and actinolite

OZs

Stonewall Gneiss (Middle Ordovician? to Late Proterozoic?)—Gray to grayish-brown to dark-gray, medium- to coarse-grained, commonly schistose, generally pegmatitic (biotite-muscovite-quartz-potassium feldspar pegmatites), biotite-rich gneiss with generally rare but locally fairly common layers, lenses, and pods of hornblende-plagioclase amphibolite. Locally contains small red garnets. Characteristically and commonly contains small pods and lenses of altered ultramafic rocks, now mostly soapstones and serpentinites, but originally probably pyroxenites, dunites, and peridotites. Some have original crystal textures of pyroxenites, but the crystals of pyroxene have been completely serpentinized and (or) uralitized, and many rocks are now soapstones. Intensely deformed in most outcrops. Fresh outcrops are relatively rare because unit weathers deeply; fresh rock exposed along large streams. Weathers to a uniform, slightly micaceous, dark-red saprolite and clayey, dark-red soil; vermiculitic mica is characteristic of soils formed from the Stonewall Gneiss. Lack of outcrops and the dark-red soil also are characteristic—outcrops are even rare on steep hillsides of secondary streams. Most ultramafic bodies in the Stonewall are archaeological sites because of the refractive quality of the soapstone and because of its ease in sculpting bowls, cooking utensils, and heat-retaining devices thought to have been used as bed/shelter/food warmers. Bowl fragments can be found at many sites; occasionally bowl blanks can be found still attached to the rock

OZsi

Stonewall Gneiss that has been extensively intruded by poorly foliated to unfoliated biotite-quartz-potassium feldspar-plagioclase granite, so that soil has characteristics of undivided Stonewall Gneiss, but presence of many residual boulders make weathered areas resemble those of Crider Gneiss

OZsl — Stonewall Gneiss that weathers to slabs and has been mapped as a separate unit

OZsp — Powers Ferry Member—Biotite gneiss identical to that in the undivided Stonewall Gneiss interlayered with biotite-muscovite-feldspar-quartz schist (~20–35 percent of unit) and minor scattered amphibolite

OZsg — Informal schist and gneiss member—(±Garnet)-biotite-muscovite-feldspar-quartz schist with lesser amounts of biotite gneiss and very rare amphibolite. Locally with rare kyanite or staurolite. In exposures southeast of Atlanta the schist locally contains sillimanite

OZsk — Kalves Creek Member—Coarse-grained, whitish-yellow- to white-weathering, fibrous and spindly graphite-sillimanite-feldspar-quartz schist. Graphite is in tiny platelets on fibrous sillimanite. Generally shows voids and iron stains where sulfide minerals have weathered out. In fresh core schist contains as much as 20 percent pyrite

OZsq — Quartzite—Generally thin, granular quartzite locally present in or over the Stonewall Gneiss

OZcm — **Clairmont Formation (Middle Ordovician? to Late Proterozoic?)**—Light-gray to bluish-gray, medium- to coarse-grained, generally porphyroblastic, locally porphyroclastic, generally ductilely tectonized, streaky to finely layered to granitic biotite-plagioclase-potassium feldspar gneiss containing fragments, chips, blocks, and slabs (exotic blocks) of amphibolite; amphibolite and light-gray granofels; light- to medium-gray, equigranular biotite granitic gneiss; epidosite; light-gray granofels; metagranite; clean quartzite; and rare ultramafic rocks. Autoclastic chips, blocks, and slabs ("native blocks" of Hsü, 1968) are common. Matrix is pervasively penetrated by innumerable anastomosing, recrystallized shear planes that do not pass into or through the clasts. Foliation and folds within all types of clasts (including the autoclastic clasts) terminate abruptly against the surrounding matrix. Rocks of the Clairmont have a granitized look as if they were on the verge of melting, but under the right pressure-temperature conditions so as not to complete the process. Clairmont is interpreted to be high-grade granitized mid-crustal(?), ductile tectonic mélange (Bates and Jackson, 1987, p. 410), consisting of a mélange paleosome probably composed chiefly of Late Proterozoic(?) to Middle Ordovician(?) Stonewall Gneiss and a neosome (possibly Devonian) of anatectic granite similar to the neosome of Lithonia Gneiss. The Clairmont is considered to be a facies of the Stonewall Gneiss (Ozs) and to generally have a gradational contact with the Stonewall. Weathered Clairmont that has the appearance of Stonewall Gneiss with characteristic Clairmont exotic and native blocks can be seen in roadcuts along dirt roads south, east, and southeast of Millers Mill in the southeastern corner of the Atlanta quadrangle (Stockbridge and Kellytown 7.5-min quadrangles)

OZu — **Altered meta-ultramafic rock (Middle Ordovician? to Late Proterozoic?)**—A wide variety of chloritized and (or) serpentinized ultramafic rocks generally in small bodies, tens of meters in diameter. Commonly found as cobbles and boulders. Includes soapstone and light-green to emerald-green, but mostly chlorite-green, lumpy- to spheroidally weathering chlorite-schist, generally with blue-black manganese-stained joint faces/S-planes

OZus — **Serpentinite (Middle Ordovician? to Late Proterozoic?)**—Light-green, fine-grained serpentinite with numerous S-planes

OZmp

Metapyroxenite (Middle Ordovician? to Late Proterozoic?)—Commonly composed of large (>4 mm) subhedral to euhedral pyroxene crystals that have been partially to totally replaced by a mesh of chlorite and serpentine minerals. Tends to occur as rounded boulders in/over a dark-red soil. Large bodies support sparse vegetation

OZr

Ropes Creek Metabasalt (Middle Ordovician? to Late Proterozoic?)—Fine- to medium-grained, dark-green to greenish-black, ocher-weathering, massive to finely layered, locally laminated, locally pillowed, locally chloritic, commonly garnetiferous, locally magnetite-bearing, generally pyrite-bearing, generally epidotic, hornblende-plagioclase and plagioclase-hornblende amphibolites with insignificant amounts (generally less than a very small fraction of a percent) of fine- to medium-grained, generally amphibole-bearing granofels. The final weathering product of the amphibolites is a characteristic dark-red, clayey soil. Thinly layered, medium-grained, magnetite quartzite (OZmq), in units about 0.3 to 6 m thick, is common in and characteristic of the Ropes Creek Metabasalt. The magnetite quartzite has thin (~1–4 cm) quartz-magnetite layers, with magnetite crystals as much as one centimeter in size, that alternate with quartz layers, or quartz layers with a small percentage of magnetite, about 4 to 8 cm thick. Magnetite clumps that generally disrupt the layering are locally as large as 20 cm but are commonly about one centimeter. The magnetite quartzites are locally associated with thin (<0.5 m) gondites and magnetite-spessartine quartzites, and manganiferous schist, and locally with thin (~15 cm) layers of fibrous dravite tourmaline and with pyritiferous quartzite in units about 1.5 to 4 m thick in the Atlanta quadrangle. Where there is a considerable amount of manganiferous rocks with the magnetite quartzite the quartzite has been mapped as OZmn

OZrk

Kyanite quartzite, 5 to 20 m thick, containing as much as 30 percent blue and green kyanite and 10 to 15 percent sulfide

OZrt

Amphibolite containing ~5 to 15 percent interlayered, light-gray to white, white-weathering, biotite (<10 percent)-quartz-plagioclase gneiss that strongly resembles metatrondhjemite gneisses (OZmt) and the Villa Rica Gneiss (OZv)

OZrf

Plagioclase-hornblende gneiss composed of blackish-green, ochre-weathering, flaggy to massive, medium- to coarse-grained plagioclase-hornblende, with little or no felsic material

OZrh

Coarse-grained hornblende-plagioclase gneiss that weathers to a medium-red soil with spheroidal boulders; present in a fault slice in the Oak Mountain fault zone near Ithaca, south of Villa Rica. Locally there are mappable units (POra) of sheared and altered amphibolite that also contain dikes and sills of granitic material; in many outcrops these units strongly resemble the Paulding Volcanic-Plutonic Complex in color and weathering characteristics, but lack its chaotic nature and its ultramafic rocks

OZrs

Spheroidally weathering amphibolite (Middle Ordovician? to Late Proterozoic?)—Dark-green, medium- to coarse-grained, salt-and-pepper-textured, massive and flaggy, spheroidally weathering amphibolite. Holds up low ridges and knobs. Weathers to a dark-red soil with residual cobbles and boulders or flags

OZv

Villa Rica Gneiss (Middle Ordovician? to Late Proterozoic?)—Light-gray to white, medium-grained, massive biotite-quartz-sodic plagioclase metatrondhjemite; biotite is minor. Locally layered near contacts. Sea-floor pelites of the allochthonous oceanic assemblage locally have very large garnets for tens of meters from their contact with the Villa Rica Gneiss, but it is indeterminate whether or not the garnets are the result of contact metamorphism caused by intrusion of the plutonic protolith of the Villa Rica Gneiss. Tends to form pavement outcrops where poorly jointed. Has many xenoliths of Ropes Creek Metabasalt, and locally, xenoliths of ultramafic rocks. The ultramafic rocks occur in a linear fashion suggesting tectonic emplacement, but lack of exposure prevents determination of the nature of the gneiss between the ultramafic pods. Weathers to white soils that overlie pink to white clayey saprolites. In north-central part of Villa Rica Gneiss body a thick dike of vein-quartz and altered gneiss around it have been mined for gold (Pate, 1980)

OZmt

Metatrondhjemite gneisses (Middle Ordovician? to Late Proterozoic?)—A complex of several varieties of potassium feldspar-poor gneisses and metatrondhjemites. The most common variety, which probably makes up 85 to 90 percent of the unit, is identical to Villa Rica Gneiss. Other varieties include a coarse-grained, poorly foliated biotite (generally less than 2 percent)-quartz-plagioclase gneiss/granofels with minor amounts of a dark-green amphibole; and a biotite-quartz-plagioclase gneiss that weathers to a dark-pink saprolite. Fresh rocks are rare enough to be anomalous. Most structural measurements are on amphibolites within the gneisses

OZkm

Informal migmatite of Kennesaw Mountain (Middle Ordovician? to Late Proterozoic?)—Massive, light-gray to nearly white, medium-grained, potassium feldspar-poor, biotite-quartz-plagioclase gneiss identical to metatrondhjemite gneisses (OZmt) and Villa Rica Gneiss (OZv), but with abundant xenoliths of Ropes Creek Metabasalt

OZw

Wahoo Creek Formation (Middle Ordovician? to Late Proterozoic?)—Characteristically composed of a wide variety of lithologies, the Wahoo Creek characteristically forms knobby and hilly topography. The most common lithology in the Wahoo Creek is slabby, finely layered to massive biotite gneiss, identical to the biotite gneiss of the Stonewall Gneiss, that weathers initially to a clayey saprolite with vermiculitic micas and finally to a dark-red featureless soil with vermiculitic micas. The Wahoo Creek also includes light-gray to nearly white, fine- to medium-grained, muscovite-plagioclase-quartz-potassium feldspar gneiss that is distinctively slabby, generally finely layered, and commonly contains porphyroblasts of potassium feldspar and pitted weathering surfaces. Interlayered with the light-colored gneiss, and diagnostic of the formation, are thinly layered (centimeter-size), evenly layered, epidote-, calcite-, and green diopside-bearing calc-silicate gneisses that appear to scale-off in outcrop. Salt-and-pepper-textured amphibolite and epidote amphibolite are also common lithologies and hornblendite is also found in the Wahoo Creek. Another characteristic lithology in the Wahoo Creek is a dense, glassy-appearing, hard (nearly flint-like), dark-bluish-gray epidote quartzite. The wide variety of lithologies in the Wahoo Creek have been documented by Wallace (1981). The contacts between the Wahoo Creek, Stonewall Gneiss, and allochthonous assemblage mixed unit (OZm) are difficult to map where only saprolite is present, because all three weather to identical dark-red saprolite and soil that contains vermiculitic mica; the contacts are chosen on the basis of topography (Wahoo Creek is more resistant to erosion and forms rugged, relatively high-relief topography; Stonewall Gneiss is commonly less resistant to erosion and tends to produce more subdued topography with little relief; mixed unit tends to form topography intermediate between the other two, with low, narrow ridges held up by magnetite and (or) manganiferous quartzites), presence of residual slabs of slabby gneiss (Wahoo Creek), and presence (Wahoo Creek) or absence of calc-silicate gneiss, and presence (mixed unit) or absence of magnetite and (or) manganiferous quartzite

OZcr

Crider Gneiss (Middle Ordovician? to Late Proterozoic?)—Gray to nearly white, massive to slabby, medium- to coarse-grained, poorly to well-foliated biotite-muscovite-quartz-plagioclase gneiss that is locally contorted and generally weathers to a light-tan to dark-yellowish-tan soil containing corestones of gneiss. The gneiss is commonly found as residual boulders where the unit is deeply weathered

OZcc

Beds and lenses of finely laminated to massive calc-silicate rock bearing diopside and, locally, diopside and garnets in a 5-km-long belt of Crider Gneiss northwest of Villa Rica; this calc-silicate-bearing gneiss is similar to some calc-silicate-bearing gneisses in the Wahoo Creek Formation

OZm **Mixed unit (Middle Ordovician? to Late Proterozoic?)**—Lustrous, medium- to coarse-grained (±garnet)-sillimanite-biotite-muscovite schist that is locally slightly graphitic and is commonly slightly manganiferous, and medium- to coarse-grained, locally porphyroblastic biotite-quartz-plagioclase and biotite-quartz-potassium feldspar-plagioclase gneisses, light-gray, medium-grained granite gneisses, fine- to medium-grained, dark-green, ocher-weathering hornblende-plagioclase and plagioclase-hornblende amphibolites. Locally contains garnet-(±chlorite)-biotite-muscovite-quartz-feldspar gneisses. Generally contains pods and lenses of chlorite, hornblende, and actinolite schists. Characteristic of the mixed unit is the presence of scattered 0.3- to 1-m-thick beds of fine-grained, blocky and sooty weathering (±magnetite)-spessartine quartzite (gondite, coticule rock) (Ozmm), commonly interbedded with medium-grained, pink- to purple-weathering garnet-sillimanite-biotite-quartz-muscovite schist and fine- to medium-grained, dark-green to blackish-green, ocher-weathering hornblende-plagioclase amphibolite. Brown- to blackish-weathering manganiferous schists are commonly interbedded with the manganiferous quartzite and manganiferous schists also occur without the quartzite

OZmgs Garnet-rich schist—Gray, lustrous, tan- to yellowish-weathering, quartzose, garnet-rich muscovite-biotite schist containing medium to large (6 mm–1.5 cm) garnets. Garnets are so abundant that they cover the ground in most places. Kyanite is locally present

OZmm **Spessartine quartzite (Middle Ordovician? to Late Proterozoic?)**—Light-gray, dark-pink speckled, fine-grained, blocky and sooty weathering, (±magnetite)-spessartine quartzite (gondite, coticule rock) in beds about 0.3 to 1 m thick, commonly interbedded with medium-grained, pink- to purple-weathering garnet-sillimanite-biotite-quartz-muscovite schist and fine- to medium-grained, dark-green to blackish-green, ocher-weathering hornblende-plagioclase amphibolite. Brown- to blackish-weathering manganiferous schists are commonly interbedded with the manganiferous quartzite. Commonly only seen weathered to "black quartzite"

OZmq **Magnetite quartzite (Middle Ordovician? to Late Proterozoic?)**—Thinly layered (< 1 cm) to laminated, medium-grained, magnetite quartzite in units about 0.3 to 6 m thick. Commonly has thin (~1–4 cm) quartz-magnetite layers, with magnetite crystals as much as one centimeter in size, but commonly about one millimeter, that alternate with 4- to 8-cm-thick quartz layers with or without a small percentage of magnetite. Magnetite clumps that generally disrupt the layering are locally as large as 20 cm but are commonly about one centimeter

OZmn **Manganiferous schist and gondite (Middle Ordovician? to Late Proterozoic?)**—Gray to brown manganiferous schist containing layers and lenses of blocky, sooty-weathering spessartine-quartzite (gondite, coticule rock), manganiferous magnetite quartzite, and interbedded hornblende-plagioclase amphibolite. Locally contains magnetite quartzite

OZgb **Informal mixed unit of Goldmine Branch (Middle Ordovician? to Late Proterozoic?)**—Deeply weathered, poorly exposed, feldspathic biotite gneiss, tan-weathering garnet-muscovite schist, and hornblende-plagioclase amphibolite, with scattered thin layers/lenses of manganiferous schist and thin manganiferous quartzite (gondite). Poorly exposed even along creeks because of deep weathering nature of feldspathic gneiss. Forms dark-red soil with layers of weathered schist and ocher-colored saprolite of amphibolite. Soil and saprolite are darker red and contain less quartz than that of metagraywackes in Bill Arp Formation

OZcl **Clarkston Formation (Middle Ordovician? to Late Proterozoic?)**—Medium-grained, lustrous, purple- to pink-weathering, sillimanite-(±garnet)-quartz-plagioclase-biotite-muscovite schist and lesser amounts of fine-grained, dark-green hornblende-plagioclase amphibolite generally interlayered on a scale of 1 to 20 m; locally contains small amounts of biotite-plagioclase gneiss. Sillimanite is present in nearly every outcrop, and in some outcrops it forms white to yellow spindles within the schist

XENOLITHS AND ROOF PENDANTS IN CARBONIFEROUS GRANITES

OZss **Sillimanite schist (Middle Ordovician? to Late Proterozoic?)**—Sillimanite schist not assigned to any formation. Generally coarse-grained (±garnet)-sillimanite-biotite-muscovite-quartz-plagioclase schist

OZa **Amphibolite (Middle Ordovician? to Late Proterozoic?)**—Generally fine- to medium-grained, hornblende-plagioclase and (or) plagioclase-hornblende amphibolites, commonly with nematoblastic or, less commonly, salt and pepper textures

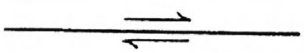
EXPLANATION OF MAP SYMBOLS

Contact—Dashed where approximately located; dotted where concealed by alluvial deposits

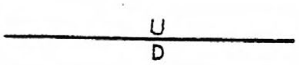
FAULTS

Fault types may be combined where there is evidence for more than one kind of displacement

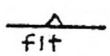
Thrust fault—Dashed where approximately located; sawteeth on upper plate, regardless of direction of dip



Strike-slip fault—Dashed where approximately located; queried where inferred; arrows indicate relative displacement



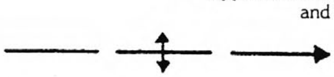
High-angle dip-slip fault—Dashed where approximately located; U, upthrown side; D, downthrown side



Strike and dip of minor fault—Site of measurement is at middle of side of triangle adjacent to strike line

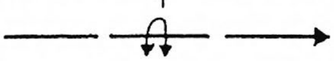
FOLDS

Approximate axial trace of major fold; arrows indicate direction of plunge; fold set identified by f_e for early folds and f_{en} for en echelon folds; in some cases more than one set of early folds constitutes f_e

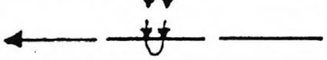


Antiform

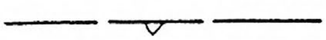
Synform



Overturned antiform



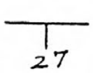
Overturned synform



Reclined fold including sheath fold—Triangle indicates direction of dip of axial plane

PLANAR FEATURES

Because structure symbols are nearly 0.25 km long on the map, their combination may yield impossible geometric features where those linear features are not associated with the planar feature represented by the symbol

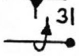


Strike and dip of bedding in unmetamorphosed Fort Payne Chert—Site of measurement at junction of dip line with strike line

Strike and dip of foliation parallel to bedding or original compositional layering—Foliation characterized by alignment of micas and (or) amphiboles and (or) feldspars and (or) quartz; ball indicates top known from sedimentary structures; site of measurement is at middle of side of triangle adjacent to strike line

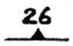
Inclined


Vertical



Overturned

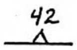
Strike and dip of main schistosity, foliation, or cleavage where compositional layering is absent —Foliation characterized by alignment of micas and (or) amphiboles and (or) feldspars and (or) quartz; site of measurement is at middle of side of triangle adjacent to strike line



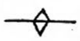
Inclined


Vertical

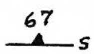
Strike and dip of second cleavage or schistosity characterized by alignment of micas and (or) amphiboles and generally parallel to axial plane of fold —Sometimes cuts across compositional layering and (or) schistosity in the closure of the fold; site of measurement is at middle of side of triangle adjacent to strike line



Inclined


Vertical

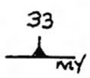
Strike and dip of schistosity caused by shearing —Site of measurement is at middle of side of triangle adjacent to strike line



Inclined

Vertical

Strike and dip of mylonitic layering —Site of measurement is at middle of side of triangle adjacent to strike line



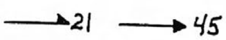
Inclined

Vertical

LINEAR FEATURES

May be combined with planar features; their intersection marks the site of measurement; where not combined, site of measurement is indicated by ball at end of or along symbol line

Bearing and plunge of tight to isoclinal minor fold axis —Where half arrow is shown, barb is on side that moved up for sense of drag

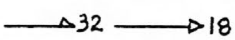


Inclined

Vertical


Horizontal

Bearing and plunge of open fold axis —Where half arrow is shown, barb is on side that moved up for sense of drag

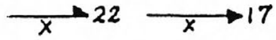


Inclined

Vertical


Horizontal

Bearing and plunge of tight to isoclinal fold in xenolith not shown as xenolith on map because of size —Where half arrow is shown, barb is on side that moved up for sense of drag



Inclined

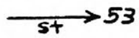
Horizontal

Bearing and plunge of mineral alignment (M**) or rodding (**R**)**—Symbols without R or M may be either mineral alignment or rodding

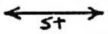
Inclined

Horizontal

Bearing and plunge of streaking lineation

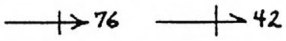


Inclined



Horizontal

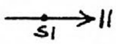
Bearing and plunge of crenulation —Where half arrow is shown, barb is on side that moved up for sense of drag



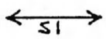
Inclined

Horizontal

Bearing and plunge of slickensides



Inclined



Horizontal

OTHER SYMBOLS

Kinematic indicators

Sense of shear derived from porphyroblasts (Simpson, 1986; Passchier and Simpson, 1986)—Only dextral shear indicators were seen

Sense of movement derived from minor folds

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CORRELATION OF MAP UNITS

ATLANTA, GA. 30'x 60' QUADRANGLE