U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science Directorate
Geologic Resources Division

Chattahoochee River National Recreation Area

GRI Ancillary Map Information Document

Produced to accompany the Geologic Resources Inventory (GRI) Digital Geologic Data for Chattahoochee River National Recreation Area

chat_geology.pdf

Version: 4/18/2022

Geologic Resources Inventory Map Document for Chattahoochee River National Recreation Area

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Geologic Resources Inventory Map Document

Chattahoochee River National Recreation Area, Georgia

Document to Accompany Digital Geologic-GIS Data

chat_geology.pdf

Version: 4/18/2022

This document has been developed to accompany the digital geologic-GIS data developed by the Geologic Resources Inventory (GRI) program for Chattahoochee River National Recreation Area, Georgia (CHAT).

Attempts have been made to reproduce all aspects of the original source products, including the geologic units and their descriptions, geologic cross sections, the geologic report, references and all other pertinent images and information contained in the original publication.

This document contains the following information:

1) **About the NPS Geologic Resources Inventory Program** – A brief summary of the Geologic Resources Inventory (GRI) Program and its products. Included are web links to the GRI GIS data model, and to the GRI products page where digital geologic-GIS datasets, scoping reports and geology reports are available for download. In addition, web links to the NPS Data Store and GRI program home page, as well as contact information for the GRI coordinator, are also present.

2) **GRI Digital Maps and Source Citations** – A listing of the GRI digital geologic-GIS maps produced for this project along with source maps used in their completion. In addition, a brief explanation of how each source map was used is provided.

3) **GRI Digital Bedrock Geologic-GIS Map (Northern portion)**

   a) **Map Unit List** – A listing of all bedrock geologic map units present on this map, generally listed from youngest to oldest.

   b) **Map Unit Descriptions** – Text addressing the lack of unit descriptions, beyond the unit name, for all bedrock geologic map units present on this map.

   c) **Ancillary Source Map Information** – Additional source map information pertaining to the source map.

4) **GRI Digital Bedrock Geologic-GIS Map (Southern portion)**

a) **Map Unit List** – A listing of all bedrock geologic map units present on this map, generally listed from youngest to oldest.

b) **Map Unit Descriptions** – Unit descriptions for all bedrock geologic map units present on this map.

c) **Geologic Cross Section** – The geologic cross section graphic (A;A', partial extent) that is within the extent of the GRI digital geologic-GIS data.

d) **Ancillary Source Map Information** – Additional source map information pertaining to the source map.

5) **GRI Digital Bedrock Geologic-GIS Map (Sandy Spring Quadrangle)**

a) **Map Unit List** – A listing of all bedrock geologic map units present on this map, generally listed from youngest to oldest.

b) **Map Unit Descriptions** – Unit descriptions for all bedrock geologic map units present on this map.

c) **Ancillary Source Map Information** – Additional source map information pertaining to the source map.

6) **GRI Digital Shoals and Underwater Hazard Areas-GIS Map**

a) **Photograph Localities** – Photographs related to observation localities within the GRI digital geologic-GIS data.

b) **Ancillary Source Map Information** – Additional source map information pertaining to the source map. Includes data collection information and metadata information relevant to the source GIS data and GRI digital geologic-GIS data.

7) **GRI Digital Data Credits** – GRI digital geologic-GIS data and ancillary map information document production credits.

For information about using GRI digital geologic-GIS data contact:

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Geologist/GIS Specialist/Data Manager
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About the NPS Geologic Resources Inventory Program

Background

The Geologic Resources Inventory (GRI) provides geologic map data and pertinent geologic information to support resource management and science-informed decision making in more than 270 natural resource parks throughout the National Park System. Geologic resources for management consideration include both the processes that act upon the Earth and the features formed as a result of these processes. Geologic processes include: erosion and sedimentation; seismic, volcanic, and geothermal activity; glaciation, rockfalls, landslides, and shoreline change. Geologic features include mountains, canyons, natural arches and bridges, minerals, rocks, fossils, cave and karst systems, beaches, dunes, glaciers, volcanoes, and faults.

The GRI is one of 12 inventories funded by the National Park Service (NPS) Inventory and Monitoring Program. The Geologic Resources Division of the NPS Natural Resource Stewardship and Science Directorate administers the GRI. The NPS Geologic Resources Division partners with the Colorado State University Department of Geosciences to produce GRI products. Many additional partners participate in the GRI process by contributing source maps or reviewing products.

The GRI team undertakes three tasks for each park in the Inventory and Monitoring program: (1) conduct a scoping meeting and provide a summary document, (2) provide digital geologic map data in a geographic information system (GIS) format, and (3) provide a GRI report. These products are designed and written for nongeoscientists.

Products

Scoping Meetings: These park-specific meetings bring together local geologic experts and park staff to inventory and review available geologic data and discuss geologic resource management issues. A summary document is prepared for each meeting that identifies a plan to provide digital map data for the park.

Digital Geologic Maps: Digital geologic maps reproduce all aspects of traditional paper maps, including notes, legend, and cross sections. Bedrock, surficial, and special purpose maps such as coastal or geologic hazard maps may be used by the GRI to create digital Geographic Information Systems (GIS) data and meet park needs. These digital GIS data allow geologic information to be easily viewed and analyzed in conjunction with a wide range of other resource management information data.

For detailed information regarding GIS parameters such as data attribute field definitions, attribute field codes, value definitions, and rules that govern relationships found in the data, refer to the NPS Geology-GIS Data Model document available at: https://www.nps.gov/articles/gri-geodatabase-model.htm

Geologic Reports: GRI reports synthesize discussions from the original scoping meeting, follow up conference call(s), and subsequent research. Chapters of each report discuss the geologic setting of the park, distinctive geologic features and processes within the park, highlight geologic issues facing resource managers, and describe the geologic history leading to the present-day landscape. Each report also includes a poster illustrating these GRI digital geologic-GIS data.

For a complete listing of GRI products visit the GRI publications webpage: https://go.nps.gov/gripubs. GRI digital geologic-GIS data is also available online at the NPS Data Store: https://irma.nps.gov/DataStore/Search/Quick. To find GRI data for a specific park or parks select the appropriate park(s), enter “GRI” as a Search Text term, and then select the Search button.

For more information about the Geologic Resources Inventory Program visit the GRI webpage: https://www.nps.gov/subjects/geology/gri.htm. At the bottom of that webpage is a “Contact Us” link if you

need additional information. You may also directly contact the program coordinator:

Jason Kenworthy
Inventory Coordinator
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The Geologic Resources Inventory (GRI) program is funded by the National Park Service (NPS) Inventory and Monitoring (I&M) Division. Learn more about I&M and the 12 baseline inventories at the I&M webpage: https://www.nps.gov/im/inventories.htm.

GRI Digital Maps and Source Map Citations

The GRI digital geologic-GIS maps for Chattahoochee River National Recreation Area, Georgia (CHAT). Of, note, the full map titles are listed here as elsewhere, in the document outline and map topic folders, these are abbreviated to shorten their lengthy titles. Listed with each map is the source map used to produce the map and a brief explanation of how each source map was used. Additional information pertaining to the source map is also presented in the GRI Source Map Information (CHATMAP) table included with the GRI digital geologic-GIS data.

GRI Digital Bedrock Geologic-GIS Map of the Northern portion of Chattahoochee River National Recreation Area and Vicinity, Georgia (*GRI MapCode CHTN*)

> Dicken, C.L., Nicholson, S.W., Horton, J.D., Foose, M.P., and Mueller, J.A.L., 2005, Preliminary Integrated Geologic Map Databases for the United States: Alabama, Florida, Georgia, Mississippi, North Carolina, and South Carolina: U.S. Geological Survey, Open-File Report OF-2005-1323, scale 1:500,000 (Geologic Map Database (Alabama, Florida, Georgia, Mississippi, North Carolina, and South Carolina)). (*GRI Source Map ID 74109*).

Only a partial extent of the source digital data was used, however, all geologic features within this extent were captured.

GRI Digital Bedrock Geologic-GIS Map of the Southern portion of Chattahoochee River National Recreation Area and Vicinity, Georgia (*GRI MapCode CHTS*)

> Higgins, M.W., Crawford, T.J., Atkins, R.L., Crawford, R.F., 2003, Geologic Map of the Atlanta 30' x 60' Quadrangle, Georgia: U.S. Geological Survey, Geologic Investigations Series Map I-2602, scale 1:100,000 (Atlanta 30' x 60' Quadrangle). (*GRI Source Map ID 68679*).

Only a partial extent of the source digital data was used, however, all geologic features within this extent were captured.

Digital Bedrock Geologic-GIS Map of the Sandy Spring Quadrangle Area, Georgia (*GRI MapCode SASP*)

> Harden, Hailey M., Kath, Randy L., Crawford, Thomas J., 2013, Geologic Map Illustrating the Tectonostratigraphy and Structural Geology of part of the Brevard Zone in Georgia: Results from Detailed Surface Geologic Mapping in the Chattahoochee River National Recreation Area, Sandy Springs Quadrangle, Georgia: GeoCorps of America and University of West Georgia, scale 1:24,000 (Bedrock Geologic Map (Sandy Springs Quadrangle Area)). (*GRI Source Map ID 75967*).

The full extent of the source map was used, and all geologic features within this extent were captured.

In addition to the bedrock digital geologic-GIS maps, a map of shoals and water hazards is also available.

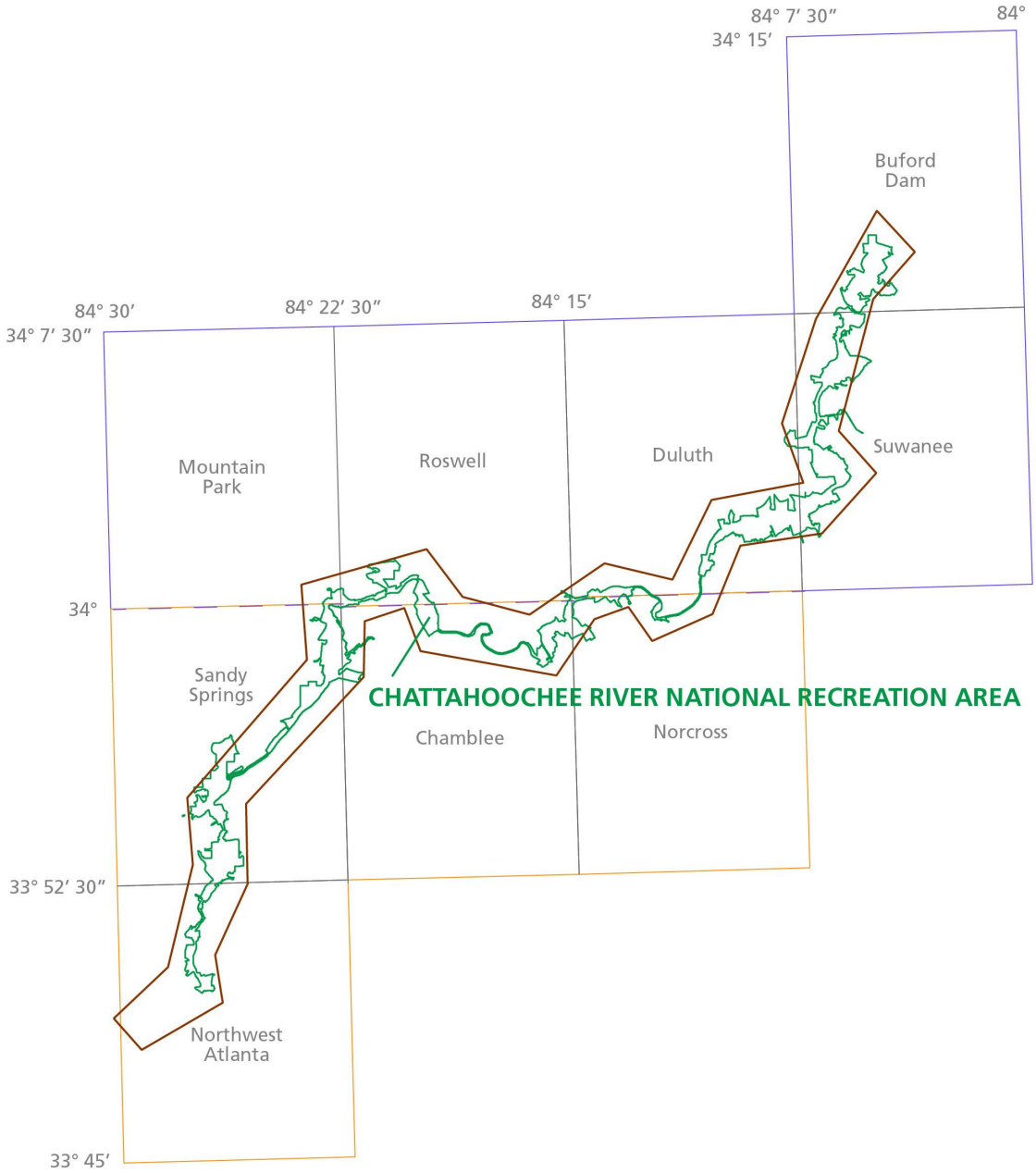
Digital Shoals and Water Hazard Areas-GIS Map of Chattahoochee River National Recreation Area, Georgia (*GRI MapCode CHSH*)

> Hundley, Jeffrey Britton, 2014, Shoals Map of Chattahoochee River National Recreation Area, Georgia: GeoCorps of America, unpublished map, scale 1:24,000 (GeoCorps of America unpublished Shoals and Underwater Hazards Map (Chattahoochee NRA)). (*GRI Source Map ID 76002*).

The full extent of the source map was used, and all shoal and hazard features within this extent were captured.

Index Map

The following index map displays the extents of the GRI digital geologic-GIS maps produced for Chattahoochee River National Recreation Area (CHAT). The extent of the GRI Digital Bedrock Geologic-GIS Map of the Northern portion of Chattahoochee River National Recreation Area and Vicinity is outlined in blue, whereas the the extent of the GRI Digital Bedrock Geologic-GIS Map of the Southern portion of Chattahoochee River National Recreation Area and Vicinity is outlined in light green. The boundary for the park (as of March, 2022) is outlined green. 7.5' quadrangles are also shown (in gray), as is the nearby partial boundary (also as of March,, 2022) for Carlsbad Caverns Nation Park (CAVE).



Index map by Stephanie O'Meara (Colorado State University).

GRI Digital Bedrock Geologic-GIS Map (Northern portion)

Map Unit List

The bedrock geologic units present in the GRI Digital Geologic-GIS Map of the Northern portion of Chattahoochee National Recreation Area and Vicinity are listed below. Units are listed with their assigned unit symbol and unit name (e.g., PZPCbg1 - Biotite gneiss). Units are generally listed from youngest to oldest. No description for water is provided. Information about each geologic unit is also presented in the Geologic Unit Information (CHTNUNIT) table included with the GRI digital geologic-GIS data.

Precambrian-Paleozoic Era

PZPCbg1 - Biotite gneiss
PZPCbg2 - Biotitic gneiss, mica schist and amphibolite
PZPCgg - Granitic gneiss, undifferentiated
PZPCa - Amphibolite
PZPCg1 - Hornblende gneiss
PZPCg2 - Hornblende gneiss and amphibolite
PZPCs - Aluminous schist
PZPCmr - Metagraywacke and mica schist
PZPCms - Mica schist, gneiss and amphibolite
PZPCq - Quartzite
PZPCu - Ultramafic rocks, undifferentiated

Age Unknown

UNKm - Mylonite and ultramylonite
UNKmds - Mafic dike or sill

Map Unit Descriptions

No unit descriptions, beyond the unit name, were present with the source map digital data..

Ancillary Source Map Information

The following section pertains to the Geologic Map Database (Alabama, Florida, Georgia, Mississippi, North Carolina, and South Carolina) source map.

Geologic Map Database (Alabama, Florida, Georgia, Mississippi, North Carolina, and South Carolina)

The formal citation for this source.

> Dicken, C.L., Nicholson, S.W., Horton, J.D., Foose, M.P., and Mueller, J.A.L., 2005, Preliminary Integrated Geologic Map Databases for the United States: Alabama, Florida, Georgia, Mississippi, North Carolina, and South Carolina, U.S. Geological Survey, Open-File Report OF-2005-1323, scale 1:500,000. (*GRI Source Map ID 74109*).

Additional information concerning this source publication including attribute tables in File Maker and DBaseIV format can be obtained at: http://tin.er.usgs.gov/geology/state/state.php?state=GA

GRI Digital Bedrock Geologic-GIS Map (Southern portion)

Map Unit List

The bedrock geologic units present in the GRI Digital Geologic-GIS Map of the Southern portion of Chattahoochee National Recreation Area and Vicinity are listed below. Units are listed with their assigned unit symbol and unit name (e.g., JTRd - Diabase). Units are listed from youngest to oldest. No description for water is provided. Information about each geologic unit is also presented in the Geologic Unit Information (CHTSUNIT) table included with the GRI digital geologic-GIS data.

Mesozoic Era

Late Triassic to Early Jurassic Periods
JTRd - Diabase

Paleozoic Era

Mississippian-Pennsylvanian to Permian Periods?
PPNMmb - Mylonitized Ben Hill Granite

Silurian? to Permian? Periods
PSm - Mylonitized granitoid

Upper Ordovician? to Permian? Periods
POb - Button schist
POms - Button schist and sheared amphibolite
Pos - Garnet Hill type altered rocks

Proterozoic Eon and Paleozoic Era

Middle Proterozoic? Eon to Permian? Period
PYl - Long Island Creek Gneiss

Middle Proterozoic? Eon to Permian? Period
PNMb - Ben Hill Granite

Devonian Period
Dl - Lithonia Gneiss, undivided

Paleozoic Era
PZgn - Unnamed granitic gneiss

Cambrian to Lower Ordovician? Periods
OCbh - Informal schist of Hullett facies

Proterozoic Eon and Paleozoic Era

Late Proterozoic Eon? to Middle Ordovician? Period
OZu - Altered meta-ultramafic rock
OZus - Serpentinite
OZs - Stonewall Gneiss
OZsp - Stonewall Gneiss, Powers Ferry Member

OZcm - Clairmont Formation
OZcr - Crider Gneiss
OZr - Ropes Creek Formation
OZw - Wahoo Creek Formation
OZm - Informal mixed unit
OZmgs - Garnet-rich schist
OZmm - Spessartine quartzite
OZcl - Clarkston Formation
OZa - Amphibolite

Paleozoic Era

Cambrian (?) Period
Caq - Thin (<2m thick) mappable units of muscovite quartzite
Ccf - Crawfish Creek Formation
Ccq - Clean quartzite units
Ccp - Chatthoochee Palisades Quartzite
Cas - Aluminous schist unit

Map Unit Descriptions

Descriptions of bedrock geologic map units present on the GRI Digital Bedrock Geologic-GIS Map of the Southern portion of Chattahoochee River National Recreation Area, generally listed from youngest to oldest, are presented below. Unit ages listed from one period of geologic time to another are listed from "oldest to youngest" (e.g., Late Triassic to Early Jurassic) despite the format the source publication used. Source map unit symbols of "C" for the Carboniferous period are now symbolized by the symbol "PNM" for the two periods of geologic time, Pennsylvanian and Mississippian, that collectively comprise the Carboniferous. All unit descriptions are from the Atlanta 30' x 60' Quadrangle source map. As the GRI digital geologic-GIS data used a partial extent of the source map, some references to other units within some unit descriptions are to units not present in the GRI digital geologic-GIS data. See the source map publication for information relevant to these referenced units.

JTRd - Diabase (Late Triassic to Early Jurassic)

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 (width exaggerated on map; all dikes are shown at the same thickness). The diabase weathers to 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.

PPNMmb - Mylonitized Ben Hill Granite (Mississippian? to Permian?)

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.

PSm - Mylonitized granitoid (Silurian? to Permian?)

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 (Upper Ordovician? to Permian?)

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).

POms - Button schist and sheared amphibolite (Upper Ordovician? to Permian?)

POms - Button schist and sheared amphibolite (Permian? to Upper Ordovician?)
Derived by shearing of mixed unit (OZm) - Gray to silvery, tan-weathering (±chlorite)-quartz-sericite button schist (Higgins, 1971) with C-S texture (Berthé and other, 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 contains 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 mixed unit (OZm) of the allochthonous assemblage.

POs - Garnet Hill type altered rocks (Upper Ordovician? to Permian?)

Pos - 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 and 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.

PYl - Long Island Creek Gneiss (Middle Proterozoic? to Permian?)

PYl - Long Island Creek Gneiss (Permian? to Middle Proterozoic?)
Light- to dark gray, well-layered (layers generally about 8-40 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.

PNMb - Ben Hill Granite (Pennsylvanian and Mississippian)

Cb - Ben Hill Granite (Carboniferous)
Massive, poorly foliated to unfoliated, light-gray, porphyritic, muscovite-biotite-quartz-microcline granite, in which blocky, commonly zoned, microcline phenocrysts, locally as long as 5 cm, 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 southwestern 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.

Dl - Lithonia Gneiss, undivded (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 in 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 of other (1980; also see Covert, 1986; and Size and Khairallah, 1989), which is included in this unit on 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 amphibolites, are present in the migmatite 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 from 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.

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 amphibolites 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.

OCbh - Informal schist of Hulett facies (Cambrian to Lower Ordovician?)

OCbh - Informal schist of Hulett facies (Lower Ordovician? to Cambrian)
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, although a secondary feature, is characteristic. May be equivalent with garnetiferous Bill Arp rocks (OCbc, OCbb, OCba).

OZu - Altered meta-ultramafic rock (Late Proterozoic? to Middle Ordovician?)

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-schist, generally with blue black manganese-stained joint facies/S-planes.

OZus - Serpentinite (Late Proterozoic? to Middle Ordovician?)

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

OZs - Stonewall Gneiss (Late Proterozoic? to Middle Ordovician?)

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 gneiss with generally rare but locally fairly common layers, lenses, and pods of hornblende-plagioclase amphibolites. 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 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 bowls blanks can be found still attached to the rock.

OZsp - Stonewall Gneiss, Powers Ferry Member (Late Proterozoic? to Middle Ordovician?)

OZsp - Stonewall Gneiss, Powers Ferry Member (Middle Ordovician? to Late Proterozoic?)
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.

OZcm - Clairmont Formation (Late Proterozoic? to Middle Ordovician?)

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 Middle Ordovician(?) to Late Proterozoic(?) 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).

OZcr - Crider Gneiss (Late Proterozoic? to Middle Ordovician?)

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 commonly is found as residual boulders where the unit is deeply weathered.

OZr - Ropes Creek Metabasalt (Late Proterozoic? to Middle Ordovician?)

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.

OZw - Wahoo Creek Formation (Late Proterozoic? to Middle Ordovician?)

OZw - Wahoo Creek Formation (Middle Ordovician? to Late Proterozoic?)
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 (centimeter-size) and 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 also is found in the Wahoo Creek. Another characteristic lithology is a dense, glassy-appearing, hard (nearly flint-like), dark-bluish-gray epidote quartzite. The wide variety of lithologies in the Wahoo Creek has 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.

OZm - Informal mixed unit (Late Proterozoic? to Middle Ordovician?)

OZm - Informal 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; medium- to coarse-grained, locally porphyroblastic biotite-quartz-plagioclase and biotite-quartz-potassium feldspar-plagioclase gneisses; light-gray, medium-grained granite gneisses; and 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 commonly are interbedded with the manganiferous quartzite, and manganiferous schists also occur without the quartzite.

OZmgs - Garnet-rich schist (Late Proterozoic? to Middle Ordovician?)

OZmgs - Garnet-rich schist (Middle Ordovician? to Late Proterozoic?)
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 (Late Proterozoic? to Middle Ordovician?)

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 commonly are interbedded with the manganiferous quartzite. Commonly only seen weathered to "black quartzite".

OZcl - Clarkston Formation (Late Proterozoic? to Middle Ordovician?)

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.

OZa - Amphibolite (Late Proterozoic? to Middle Ordovician?)

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.

Caq - Thin (<2m thick) mappable units of muscovite quartzite (Cambrian?)

May be fault slices of Chattahoochee Palisades Quartzite (Sandy Springs Group). No additional information pertaining to this unit was present on the source map.

Ccf - Crawfish Creek Formation (Cambrian and Cambrian?)

(Chilhowee Group?) - Garnet-muscovite-biotite-plagioclase-quartz schist with abundant quartz stringers and pods that contains relatively abundant medium-size (~0.5 mm to ~1 cm, but locally larger) garnets. Generally contains lenses and stringers of clean quartzite as thick as several meters, but more commonly less than 2 m.

Ccq - Clean quartzite units (Cambrian and Cambrian?)

Clean quartzite units that are locally mappable within some units of the Chilhowee Group.

Ccp - Chattahoochee Palisades Quartzite (Cambrian?)

(Sandy Springs Group) - 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 tot and gradational into the aluminous schist unit (Cas). 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.

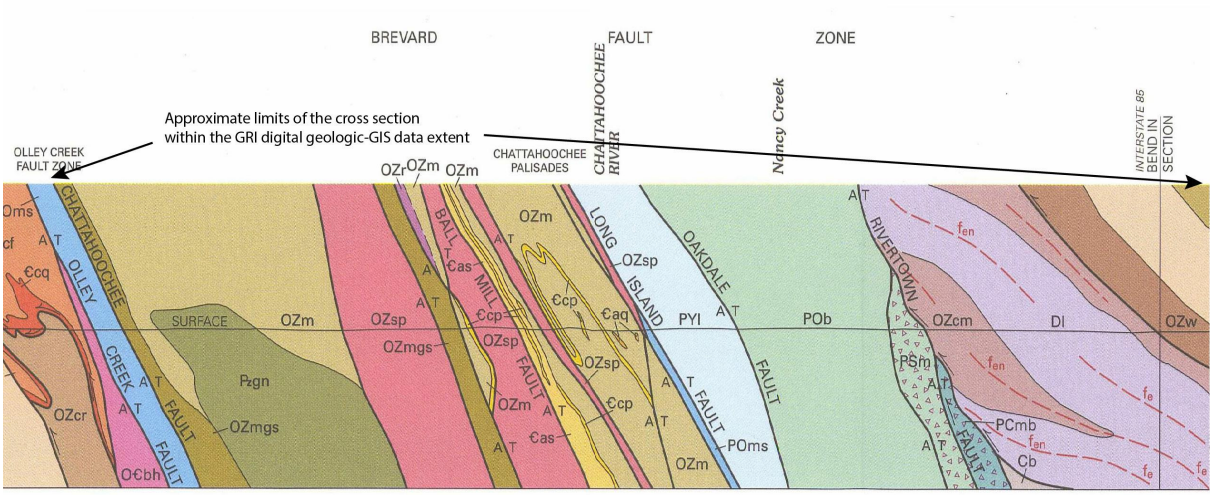
Cas - Aluminous schist unit (Cambrian?)

(Sandy Springs Group) - 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.

Geologic Cross Section

The geologic cross section present in the GRI digital geologic-GIS data produced for Chattahoochee River National Recreation Area, Georgia (CHAT) is presented below. The cross section graphic was scanned at a high resolution and thus can be viewed in more detail by zooming in (if viewing the digital format of this document).

Cross Section A-A'



Graphic from source map: Atlanta 30' x 60' Quadrangle. No vertical exaggeration denoted on source map. Of note, only a portion of the cross section graphic is within the extent of the GRI digital geologic-GIS data. This extent is presented with the cross section graphic. "A" of the cross section is to the left of the image, whereas "A'" is far to the right of the graphic.

Ancillary Source Map Information

The following section presents ancillary source map information associated with the Atlanta 30' x 60' Quadrangle source map.

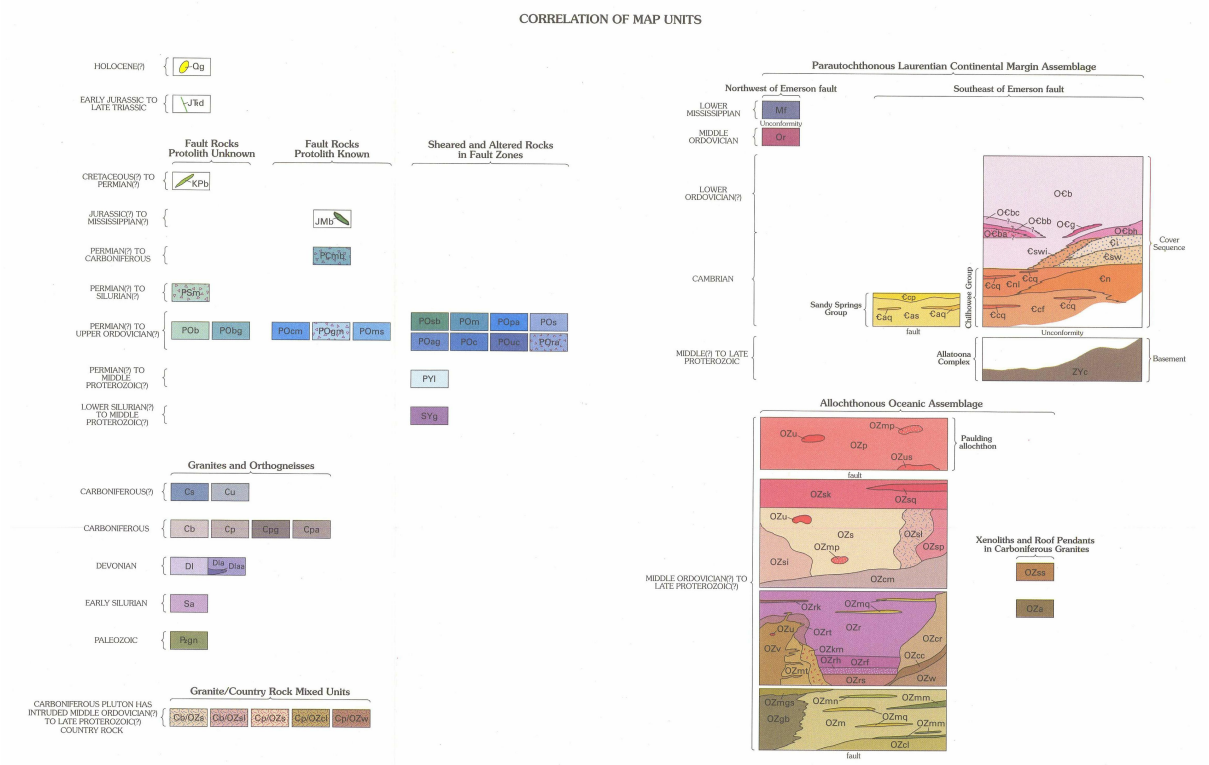
Atlanta 30' x 60' Quadrangle

The formal citation for this source.

> Higgins, M.W., Crawford, T.J., Atkins, R.L., and Crawford, R.F., 2003, Geologic Map of the Atlanta 30' x 60' Quadrangle, Georgia: U.S. Geological Survey, Geologic Investigations Series Map I-2602, scale 1:100,000 (*GRI Source Map ID 68679*).

Prominent graphics and report associated with this source map:

Correlation of Map Units



Graphic from source map: Atlanta 30' x 60' Quadrangle. Of note, some units presented in the above correlation of map units figure are not present in the GRI digital geologic-GIS data as only a portion of the source map was used.

Explanation of Map Symbols

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

Overturned thrust fault—Sawteeth point in direction of dip; bar on side of tectonically higher plate

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

U / D **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

42 / flt Inclined

flt Vertical

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
(May be combined with linear features)

27 **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

77 Inclined

Vertical

63 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

26 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

42 Inclined

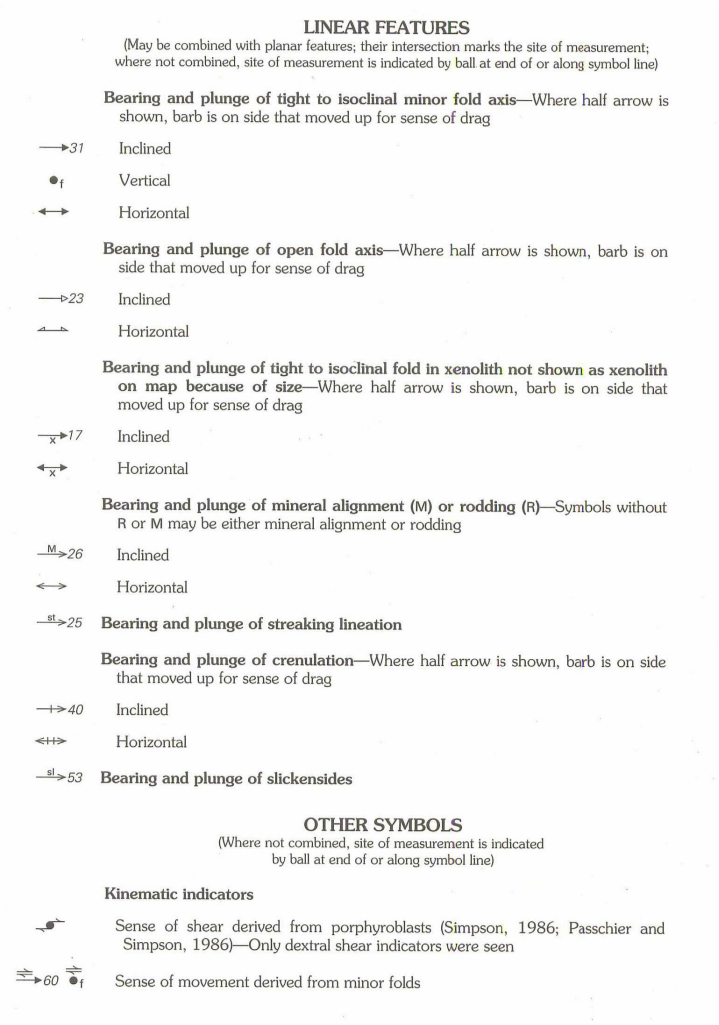
Vertical

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

67 / s Inclined

s Vertical

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



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

31 Inclined

f 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

23 Inclined

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

x 17 Inclined

x Horizontal

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

M 26 Inclined

Horizontal

st 25 **Bearing and plunge of streaking lineation**

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

40 Inclined

Horizontal

sl 53 **Bearing and plunge of slickensides**

OTHER SYMBOLS

(Where not combined, site of measurement is indicated by ball at end of or along symbol line)

Kinematic indicators

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

60 f Sense of movement derived from minor folds

Graphic from source map: Atlanta 30' x 60' Quadrangle. Of note, the map symbol explanation figure above presents all fault and fold features present on the source publication, however, only a subset of these features are actually within the extent of the GRI digital geologic-GIS data. Contacts coded as "dotted where concealed by alluvial deposits" that are within water areas were attributed as "inferred" in the GRI digital geologic-GIS data.

Report

The source map report is available as an embedded document within this document. Double-click the following link to open the report document:USGS_I-2602_report.pdf Users are encouraged to review the report as it contains information concerning the mapped geology, cross sections, and units from this source map.

GRI Digital Bedrock Geologic-GIS Map (Sandy Spring Quadrangle)

Map Unit List

The bedrock geologic units present in the GRI Digital Bedrock Geologic-GIS Map of the Sandy Spring Quadrangle Area are listed below. Units are listed with their assigned unit symbol and unit name (e.g., OZg - Granite). Units are listed from youngest to oldest. No description for water is provided. Information about each geologic unit is also presented in the Geologic Unit Information (SASPUNIT) table included with the GRI digital geologic-GIS data.

Proterozoic Eon to Paleozoic Era

Proterozoic Eon to Ordovician Period
OZg - Granite
OZli - Long Island Creek Gneiss
OZsau - Schist, amphibolite, and ultramafic
OZq - Quartzite
OZgg - Granitic-gneiss
OZpq - Palisades Quartzite
OZsg - Rottenwood Creek Mixed Unit
OZbg - Biotite gneiss
OZgs - Garnet schist
OZmg - Migmatitic gneiss
OZsh - Muscovite schist
OZgn - Gneissic granite
OZa - Amphibolite
OZps - Pappasito Schist
OZmu - Mixed schist/gneiss
OZog - Orange Gneiss

Map Unit Descriptions

Descriptions of all geologic map units, generally listed from youngest to oldest, are presented below. All unit descriptions are from the Bedrock Geologic Map (Sandy Springs Quadrangle Area) source map.

OZg - Granite (Proterozoic to Ordovician)

Biotite-quartz-feldspar granite, medium- to coarse-grained, equigranular,massive, without foliation or with a poorly developed foliation.

OZli - Long Island Creek Gneiss (Proterozoic to Ordovician)

Sphene-epidote-biotite-quartz-feldspar gneiss, medium- to coarse-grained; very felsic; yields light-colored soil; foliation is moderately well-developed.

OZsau - Schist, amphibolite, and ultramafic (Proterozoic to Ordovician)

Garnet-kyanite-feldspar-muscovite-biotite-quartz schist, fine- to coarse-grained; very quartzose, in part. Garnet kyanite-muscovite-biotite-quartz-feldspar gneiss, fine- to coarse-grained, schistose in part; quartzite; medium-grained and clean in part; also, fine to coarse-grained and micaceous and/or feldspathic. Amphibolite/hornblende gneiss, fine- to medium-grained. Ultramafic coarse-grained pyroxenes and amphibole; massive; apparently as small ovoid bodies several 10's of feet to a few 100

feet in their longest dimension.

OZq - Quartzite (Proterozoic to Ordovician)

Fine-grained, moderately- to well-foliated, locally micaceous, locally contains fine-grained black opaques.

OZgg - Granitic-gneiss (Proterozoic to Ordovician)

Biotite-quartz-feldspar gneiss, very feldspathic; quartz and feldspar are medium- to coarse-grained; biotite is fine- to medium-grained. Muscovite is present where this gneiss is sheared. Shear foliation is commonly developed.

OZpq - Palisades Quartzite (Proterozoic to Ordovician)

Fine-grained, equigranular, weakly-foliated, massive, cherty, vitreous.

OZsg - Rottenwood Creek Mixed Unit (Proterozoic to Ordovician)

Garnet (small, scarce)- biotite-muscovite-quartz-feldspar gneiss, fine- to coarse-grained; interlayered with garnet-feldspar-biotite-muscovite-quartz schist, medium- to coarse-grained; all gradations from well-developed gneiss to well-developed schist (gneiss, schistose gneiss, gneissic schist, and schist); thin zones contain abundant garnets.

OZbg - Biotite gneiss (Proterozoic to Ordovician)

Garnet (small, minor)-muscovite-biotite-quartz-feldspar gneiss, fine- to medium-grained, schistose in part; interlayered with garnet (small,minor)-biotite-feldspar-quartz-muscovite schist, medium- to coarse-grained; some garnet-rich zones, all layered with concordant and discordant pegmatite pods, lenses, and layers up to 10 feet thick; foliation wraps around pegmatite pods/lenses.

OZgs - Garnet schist (Proterozoic to Ordovician)

Kyanite-garnet-biotite-quartz-muscovite schist, coarse-grained, sheared, with abundant pegmatite pods and lenses; structurally overlain and underlain by quartzite (OZq), fine- to coarse-grained in layers 1-to 8-inches thick. The quartzite structurally overlying the schist appears to be several 10's of feet thick; while the quartzite structurally underlying the schist appears to be less than 10 feet thick.

OZmg - Migmatitic gneiss (Proterozoic to Ordovician)

Muscovite-biotite-quartz-feldspar-gneiss, with scattered small garnets, fine- to coarse-grained; concordant pegmatites and pegmatitic zones are common; quartz veins are small and scattered.

OZsh - Muscovite schist (Proterozoic to Ordovician)

Garnet-biotite-quartz-muscovite schist, coarse-grained, with tourmaline and thickly disseminated fine black opaques; sheared, with a button texture.

OZgn - Gneissic granite (Proterozoic to Ordovician)

Muscovite-biotite-quartz-feldspar gneissic granite, feldspathic; quartz and feldspar are medium- to coarse-grained; biotite is fine- to medium-grained. Shear foliation is commonly developed. Locally

contains schist xenoliths.

OZa - Amphibolite (Proterozoic to Ordovician)

Amphibole/hornblende gneiss, thinly laminated, fine- to medium-grained hornblende and plagioclase; and chlorite-actinolite schist, very fine-grained; joints are close-spaced and abundant.

OZps - Pappasito Schist (Proterozoic to Ordovician)

Garnet-biotite-muscovite-quartz-schist, coarse-grained, with thickly disseminated fine black opaques; muscovite is generally coarser-grained than biotite; sheared, with a button texture. Joints are poorly developed and scarce; shallow-weathering.

OZmu - Mixed schist/gneiss (Proterozoic to Ordovician)

Garnet-muscovite-biotite-quartz-feldspar gneiss, fine- to medium-grained, and garnet (common to abundant) -feldspar-quartz-muscovite-biotite schist, medium- to coarse-grained, interlayered; and all extensively pegmatized with coarse-grained muscovite-quartz-feldspar. Micas in the schist are often coarse-grained and in part oriented across the compositional layering creating a "tough" rock which resists breaking. This rock unit is very non-uniform. It weathers unevenly, and often in non-planar directions. Where compositional layering and foliations are well-developed, differential weathering produces a slabby outcrop. The thickness of weathering residuum varies from thin to thick over short distances; and thick residuum often contains large boulder masses of relatively fresh rock. Small, apparently ovoid bodies of biotite-quartz-feldspar granite (OZg), medium- to coarse-grained, equigranular, massive, without foliation or with a poorly developed foliation, are scattered in this unit.

OZog - Orange Gneiss (Proterozoic to Ordovician)

Biotite-quartz-feldspar gneiss, fine- to medium-grained, schistose in part; biotite-hornblende-feldspar gneiss, fine- to medium-grained; and amphibolite, fine- to medium-grained; all are interlayered or intermixed. Together, an in approximately equal parts, these three lithologies make up greater than 90 percent of this rock unit. The rock weathers to a yellow-brown, pink, or brownish gray saprolite/ residuum. The remaining part of this lithologic unit consists of small medium- to coarse-grained mafic and ultramafic bodies, apparently ovoid and several feet to a few hundred feet in their longest dimension, and muscovite-quartz-feldspar pegmatites as much as 8 to 12 feet thick. This rock unit weathers deeply to a soft, feldspathic residuum, except for the coarse-grained mafic and ultramafic bodies and the pegmatites. The coarse-grained mafics yield a hard, tough saprolite with well-developed box work; and pegmatites are present in residuum as resistant boulders.

Ancillary Source Map Information

The following section presents ancillary source map information associated with the Bedrock Geologic Map (Sandy Springs Quadrangle Area) source map.

Bedrock Geologic Map (Sandy Springs Quadrangle Area)

The formal citation for this source.

Harden, Hailey M., Kasth, Randy L., Crawford, Thomas J., 2013, Geologic Map Illustrating the Tectonostratigraphy and Structural Geology of part of the Brevard Zone in Georgia: Results from Detailed Surface Geologic Mapping in the Chattahoochee River National Recreation Area, Sandy Springs Quadrangle, Georgia, GeoCorp data, University of West Georgia, scale 1:24,000. (*GRI Source Map ID 75967*).

Prominent graphics and text associated with this source map:

Introduction

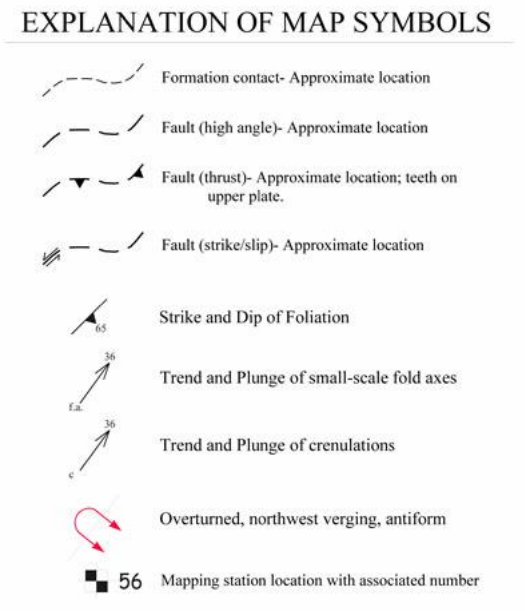
As part of the National Park Service Geologic Resources Inventory, detailed geologic mapping of part of the Sandy Springs, GA, 7.5-minute quadrangle was conducted within the Chattahoochee River National Recreation Area (CRNRA) in Cobb and Fulton Counties, Georgia, between Morgan Falls Dam and Paces Mill Park. This detailed geologic mapping revealed a complex deformational and stratigraphic history within the Brevard Zone. Additionally, this detailed mapping has provided new insight into the physical characteristics of the Brevard Zone in the metro-Atlanta area as recently described by Kath and Crawford (2006).

Exposures within the river corridor show extreme lithologic heterogeneity and structural complexity within the Brevard Zone that has not been previously documented within this area at a 1:24,000-scale. Lithologies range in textural complexity from mylonites to highly sheared schist and gneiss. Locally, retrograde mineral assemblages are present but not ubiquitous. Much previous work on the Brevard Zone defines the zone based on retrograde mineral assemblages; however, exposures along the river corridor illustrate greater textural variability as opposed to mineralogic variability.

Also, much previous work has suggested that the Chattahoochee River follows the Brevard Zone from near Gainesville, Georgia, to the Alabama-Georgia state line. However, detailed mapping within the CRNRA on the Sandy Springs and the northern part of the Northwest Atlanta Quadrangles shows that the Chattahoochee River is mostly sub-parallel (separation angle of nearly 15 degrees) to the Brevard Zone in areas where the rocks are less mechanically/chemically stable. Where the rocks are more mechanically/chemically stable, the Chattahoochee River cuts across the Brevard Zone at high angles forming abundant shoals. These overall trends give a stair step pattern to the river as it crosses the Brevard Zone in the study area.

Text from source map: Bedrock Geologic Map (Sandy Springs Quadrangle Area)

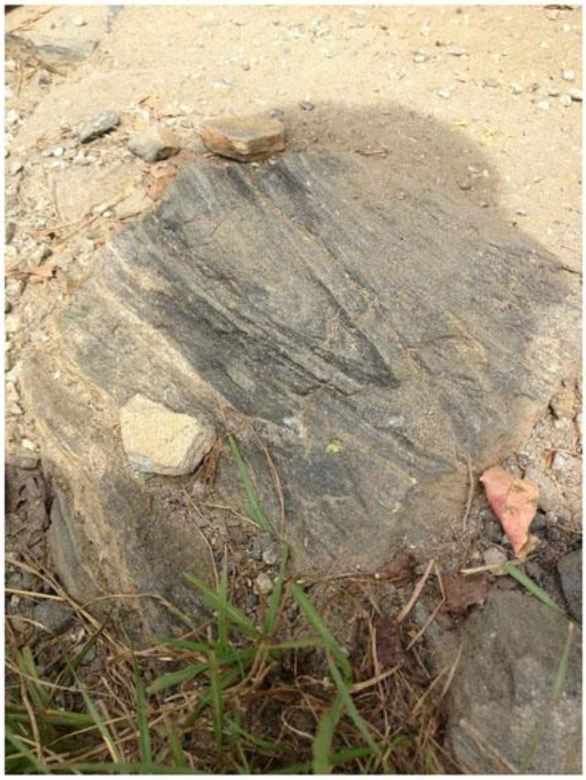
Explanation of Map Symbols



Graphic from source map: Bedrock Geologic Map (Sandy Springs Quadrangle Area)

Of note, although present on the above explanation of map symbols, no trend and plunge of small-scale fold axes are present on the source map or in the derived GRI digital geologic-GIS data.

Figure 1: Tight Fold



Nearly upright, gently plunging, tight fold in amphibolite/hornblende gneiss

Graphic from source map: Bedrock Geologic Map (Sandy Springs Quadrangle Area)

Figure 2: Biotite Gneiss



Highly sheared biotite gneiss; note mylonitic texture

Graphic from source map: Bedrock Geologic Map (Sandy Springs Quadrangle Area)

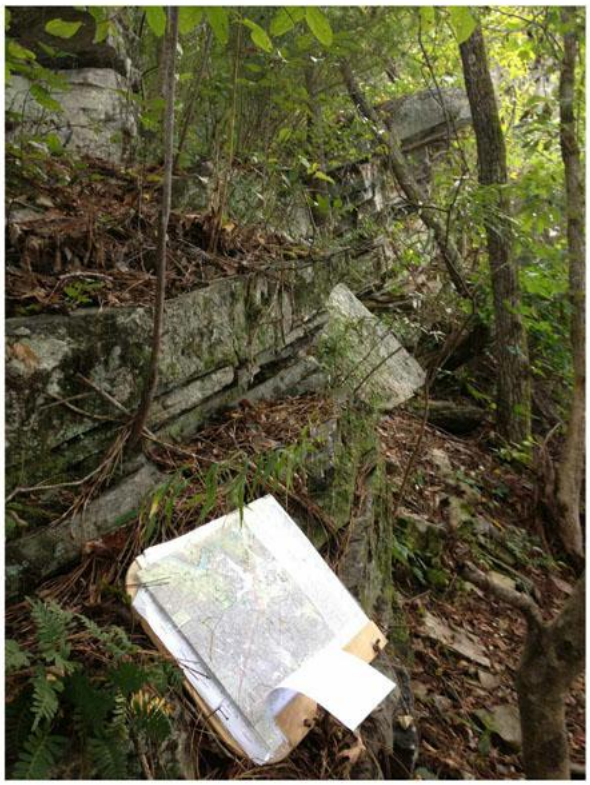
Figure 3: Brevard Zone



Typical kink/crenulation within the Brevard Zone

Graphic from source map: Bedrock Geologic Map (Sandy Springs Quadrangle Area)

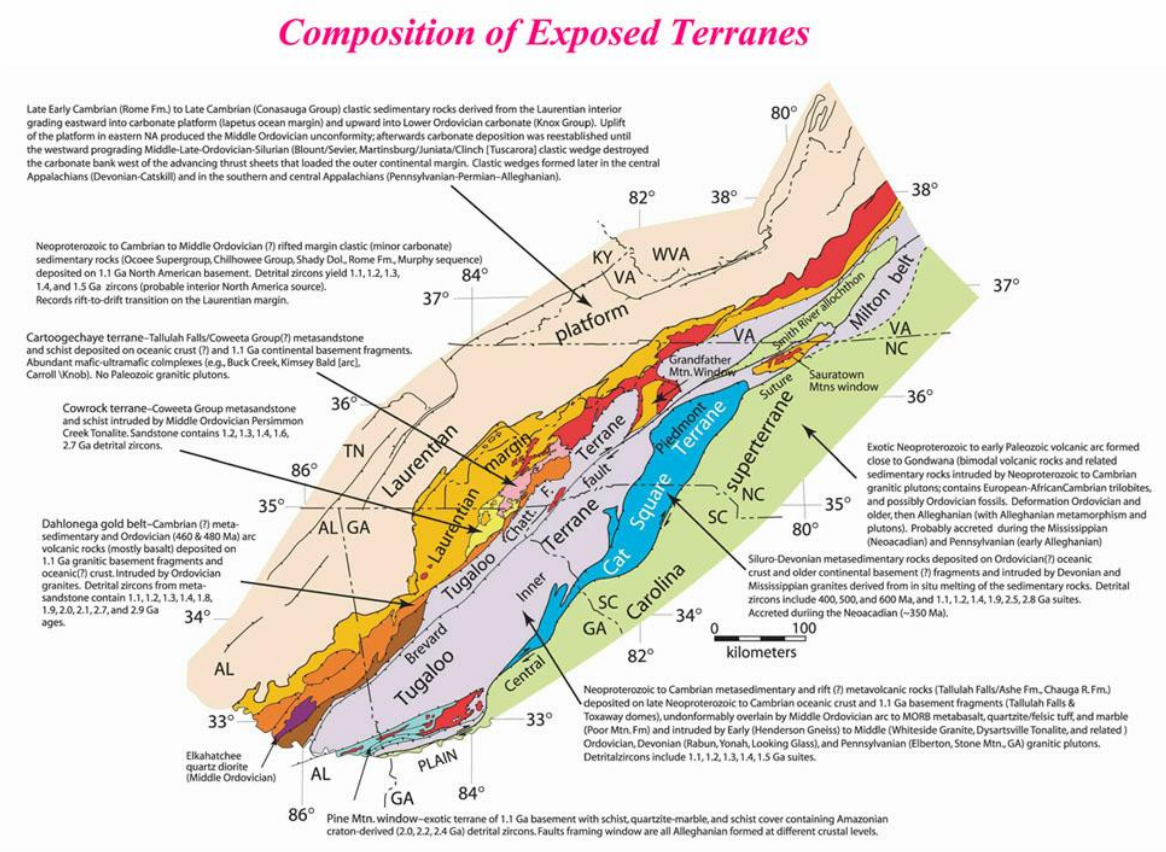
Figure 4: Gneiss/Amphibolite



Common woods exposure of feldspar-hornblende gneiss/amphibolite

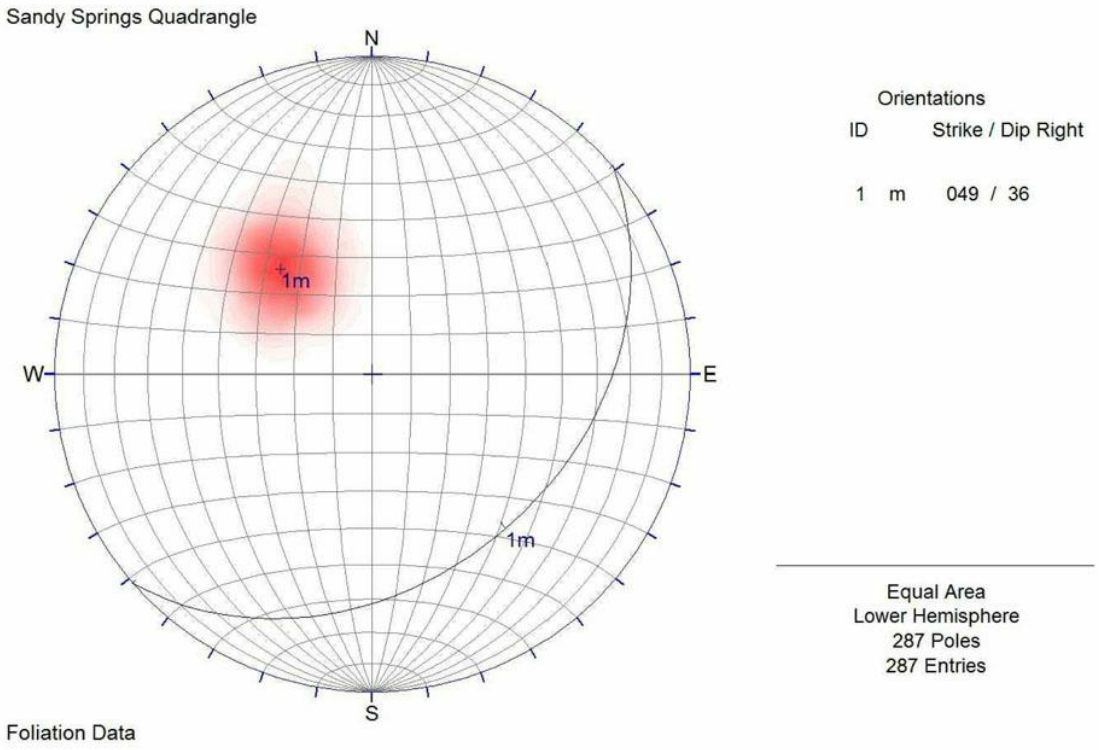
Graphic from source map: Bedrock Geologic Map (Sandy Springs Quadrangle Area)

Composition of Exposed Terranes



Graphic from source map: [Bedrock Geologic Map (Sandy Springs Quadrangle Area)]

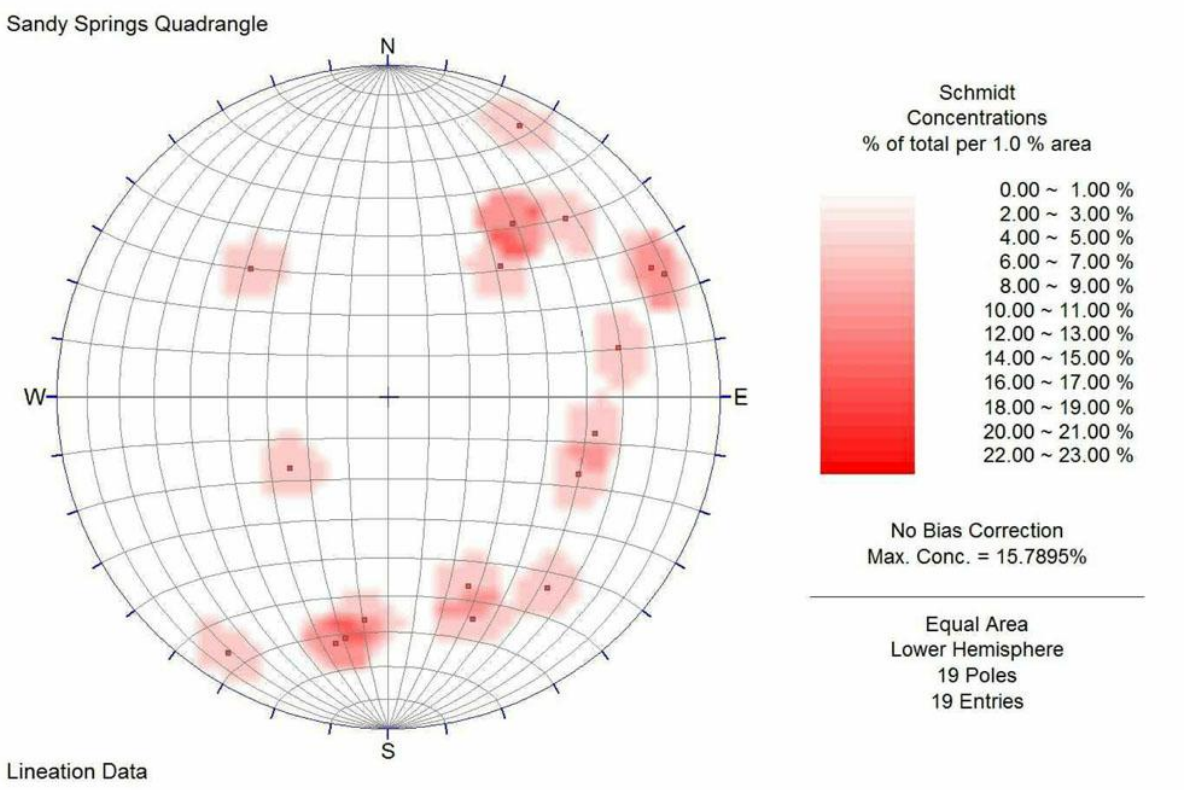
Stereonet of Foliation



Equal Area, Lower-Hemisphere Stereonet of Foliation

Graphic from source map: Bedrock Geologic Map (Sandy Springs Quadrangle Area)

Stereonet of Lineations



Equal Area, Lower-Hemisphere Stereonet of Lineations

Graphic from source map: Bedrock Geologic Map (Sandy Springs Quadrangle Area)

References

Hatcher, R.D., Jr., and Bream, B.R., 2007, New Tectonic Map of the southern and central Appalachians (v. 4.5WIP). Higgins, M.H., 1968, Geologic Map of the Brevard Fault Zone near Atlanta, Georgia: USGS IMAP 511.

Kath, R.L., and Crawford, T.J., 2006, New Insight into the Brevard Zone in Georgia: Results form Detailed Surface and Subsurface Geologic Mapping of Three Large Tunnels in the metro-Atlanta Area: Geological Society of America Abstracts with Programs, vol. 38, pp. 79

Kath, R.L., and Crawford, T.J., 2001, Detailed Geologic Mapping along the Chattahoochee Tunnel, Cobb County, Georgia: in

Kath, R.L., and Crawford, T.J., eds., Across the Brevard Zone: The Geology of the Chattahoochee Interceptor Tunnel, Cobb County, Georgia: Georgia Geological Society Guidebooks, vol. 22, No. 1, pp. 25-38.

References from source map: Bedrock Geologic Map (Sandy Springs Quadrangle Area)

Geologic Mapping Support

Geologic Mapping Supported by:

University of West Georgia, Department of Geosciences, Center for Water Resources

Geological Society of America, GeoCorps America #2013018

Text from source map: Bedrock Geologic Map (Sandy Springs Quadrangle Area)

GRI Digital Shoals and Underwater Hazard Areas-GIS Map

Photograph Localities

Present in the digital GIS data are numerous GPS localities where a photographic was taken. Each photograph locality was assigned a ID or station number (e.g., DSC0001). Included with the GRI digital geologic-GIS data for each locality is also the azimuth or direction the photograph was taken. Below are the photographs for each locality.

Source Author Note (personal communication from source author, June 6, 2015)
A few photographs are "too blurry from movement (taken on a kayak while drifting) and a couple had water droplets on the lense obscuring the image. I took the photos with my GPS' integrated camera and they were fairly difficult to quality check in the field (due to glare from sun and low resolution display screen). This also explains why several station numbers in the number sequence are missing (e.g., DSC0050 is not present). These stations are omitted from the GIS data.

All photographs taken from source map: GeoCorps of America unpublished Shoals and Underwater Hazards Map (Chattahoochee NRA)

Photograph DSC00001



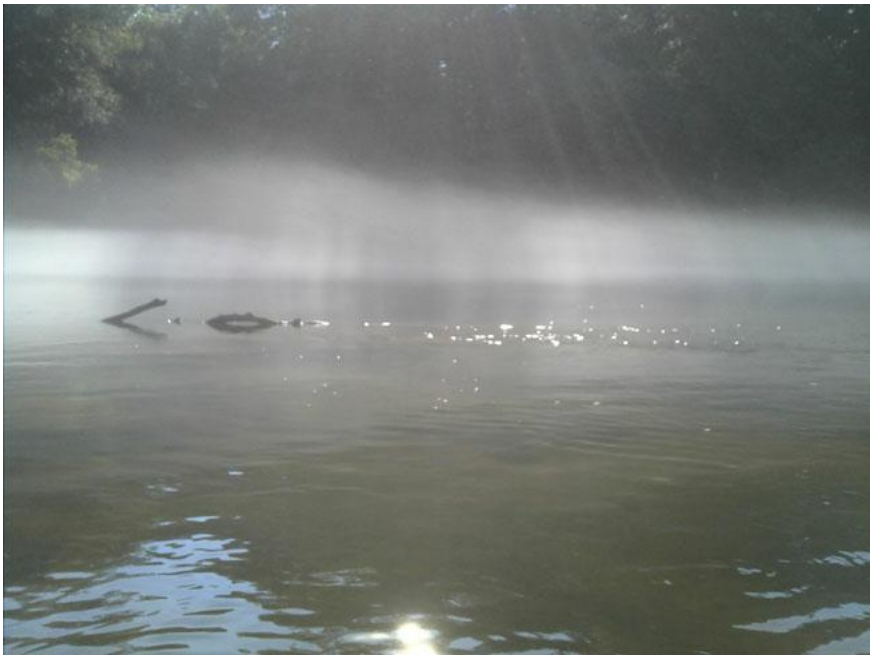
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Photograph DSC00005



Photograph DSC00006



Photograph DSC00007



Photograph DSC00008



Photograph DSC00009



Photograph DSC00010



Photograph DSC00011



Photograph DSC00012



Photograph DSC00013



Photograph DSC00014



Photograph DSC00015



Photograph DSC00016



Photograph DSC00017



Photograph DSC00018



Photograph DSC00019



Photograph DSC00020



Photograph DSC00021



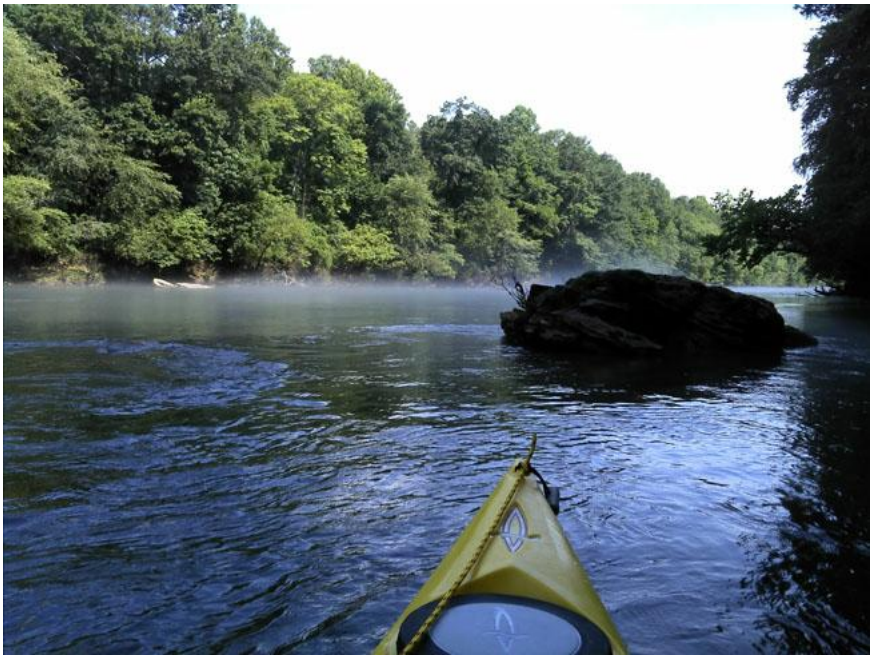
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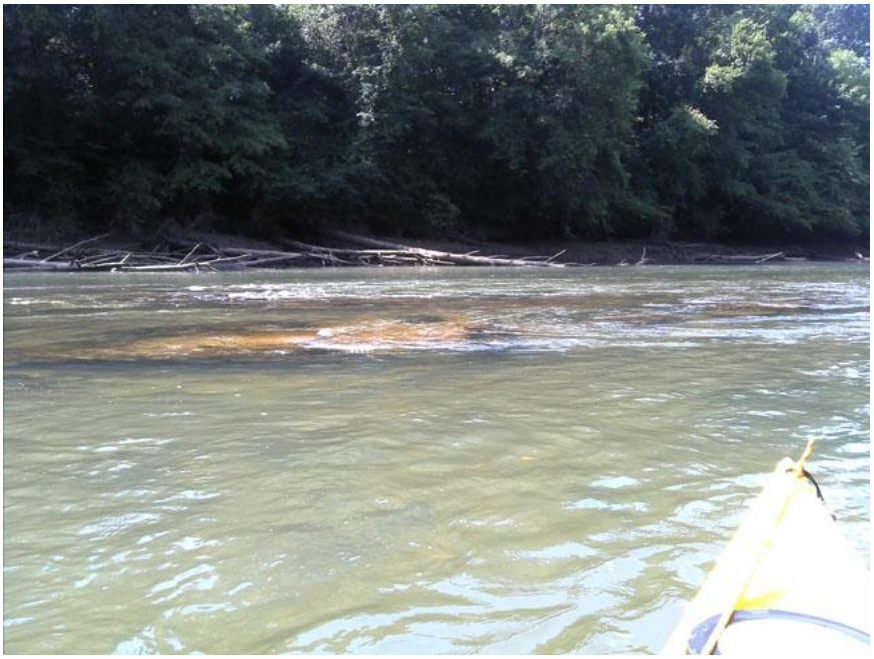
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Photograph DSC00033



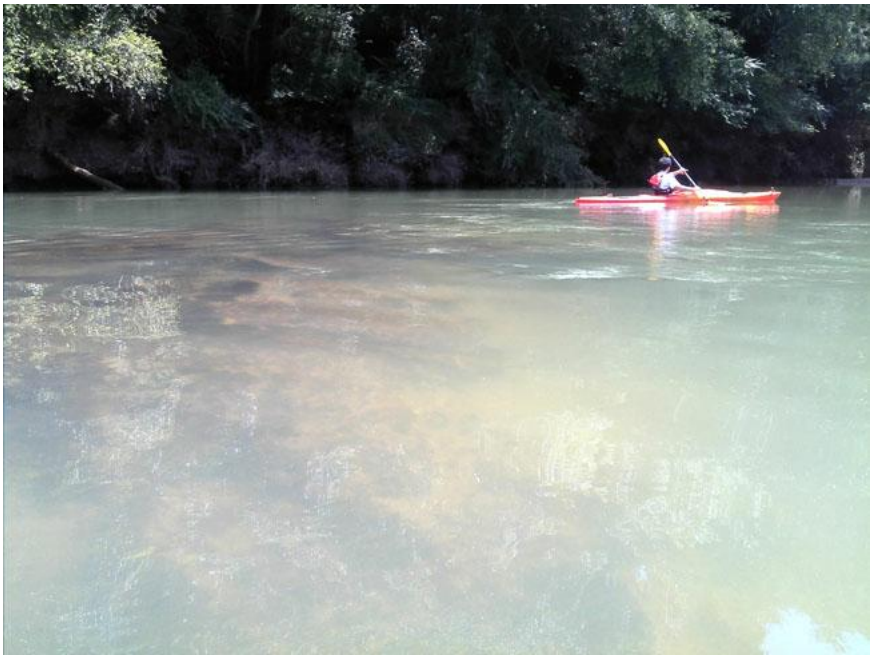
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Photograph DSC00042



Photograph DSC00043



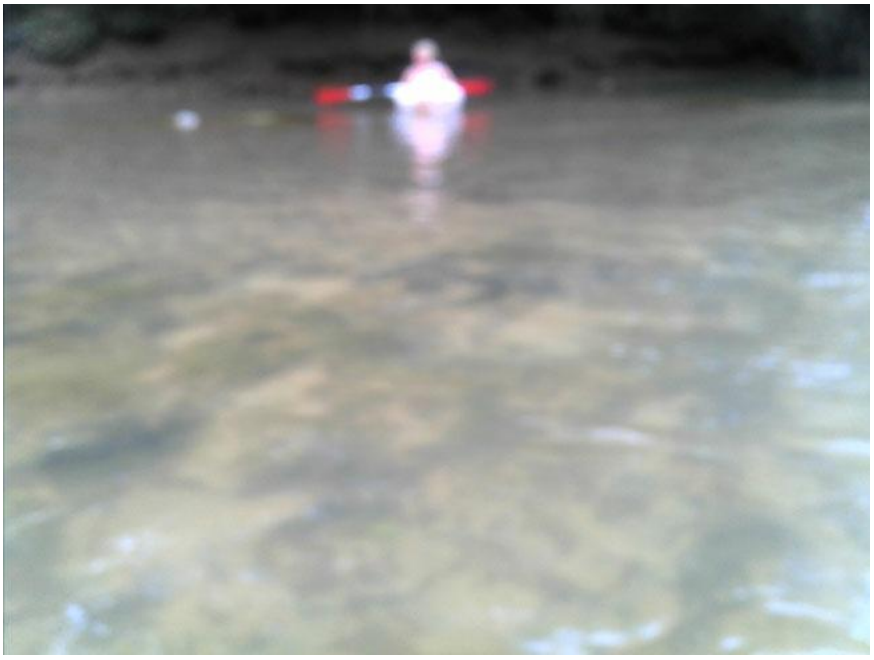
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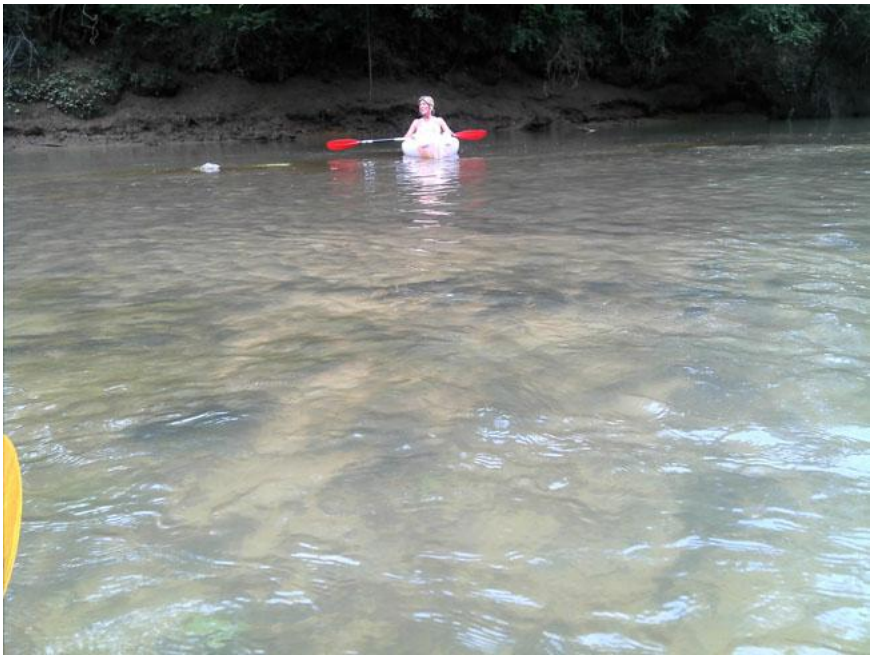
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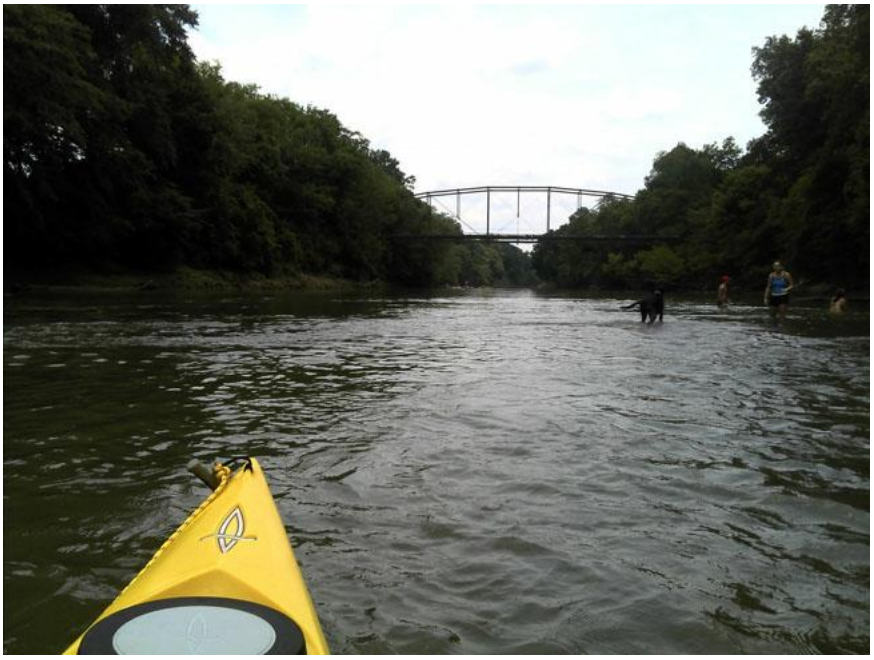
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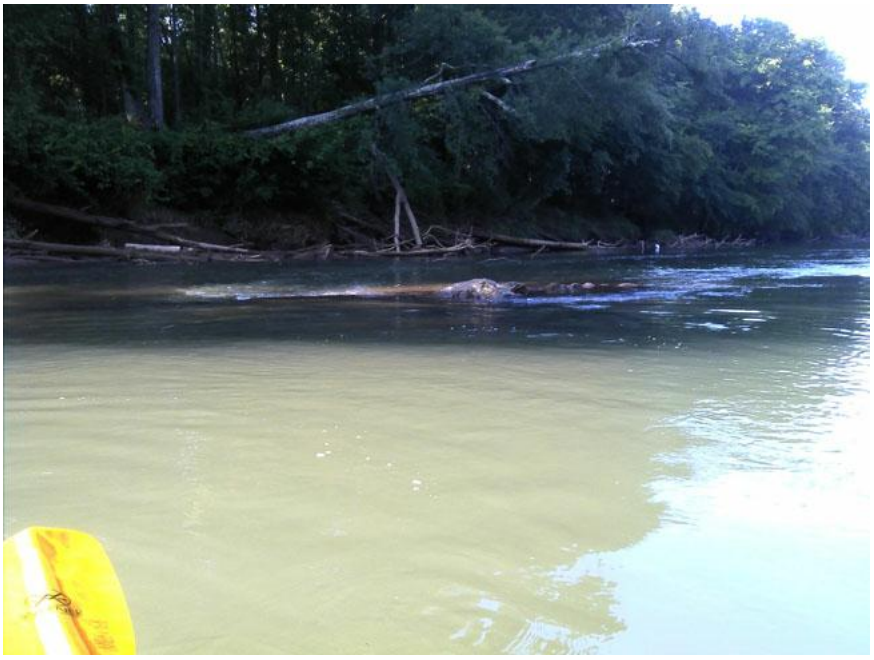
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Photograph DSC00062



Photograph DSC00063



Photograph DSC00064



Photograph DSC00065



Photograph DSC00066



Photograph DSC00067



Photograph DSC00068



Photograph DSC00070



Photograph DSC00071



Photograph DSC00072



Photograph DSC00073



Photograph DSC00074



Photograph DSC00075



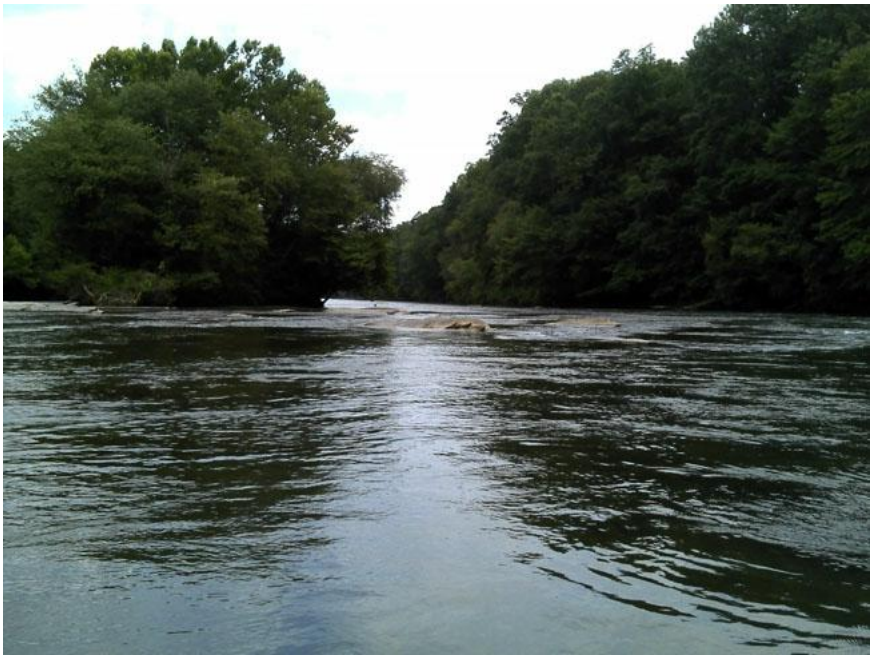
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Photograph DSC00084



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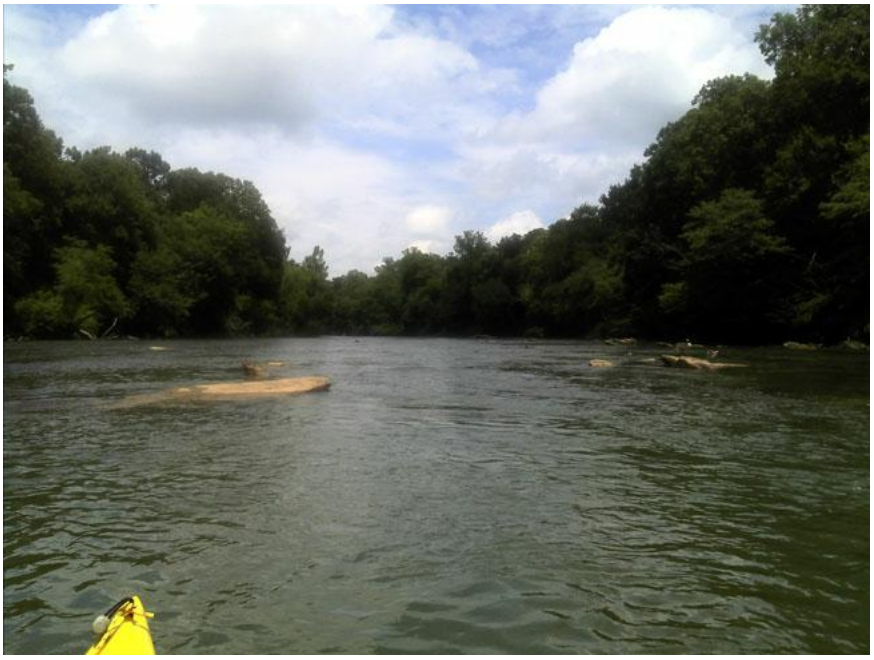
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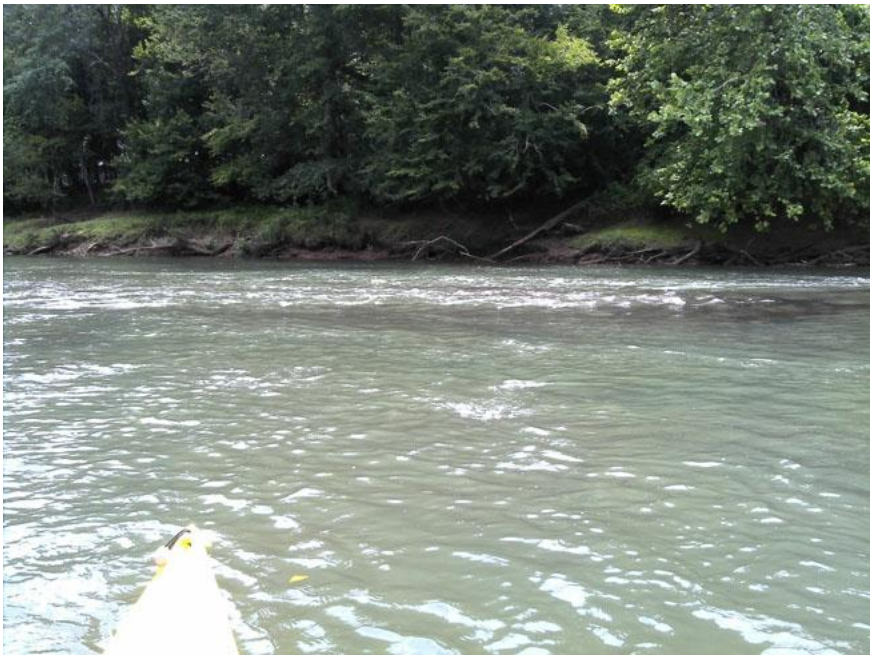
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Photograph DSC00106



Photograph DSC00107



Photograph DSC00108



Photograph DSC00109



Photograph DSC00110



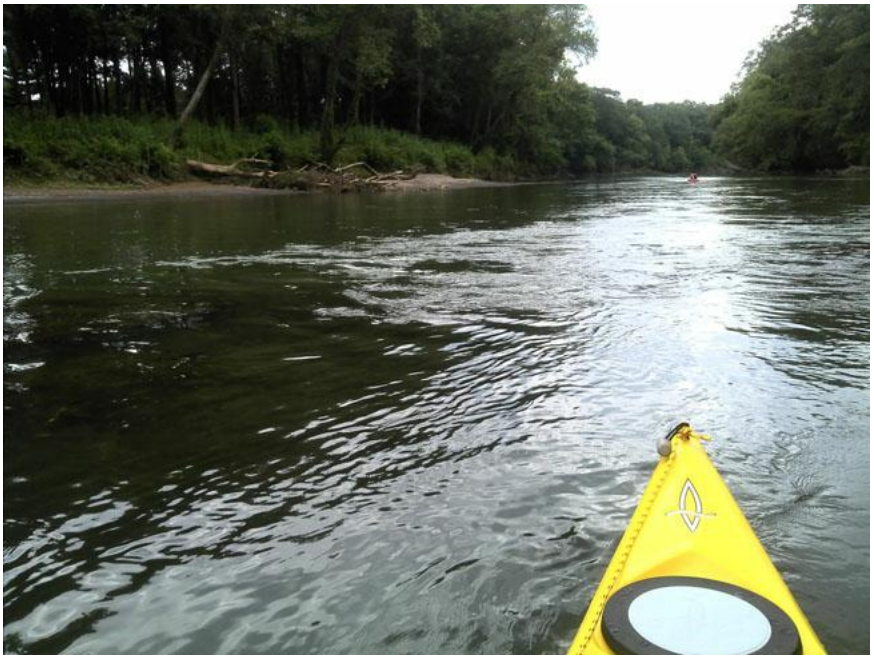
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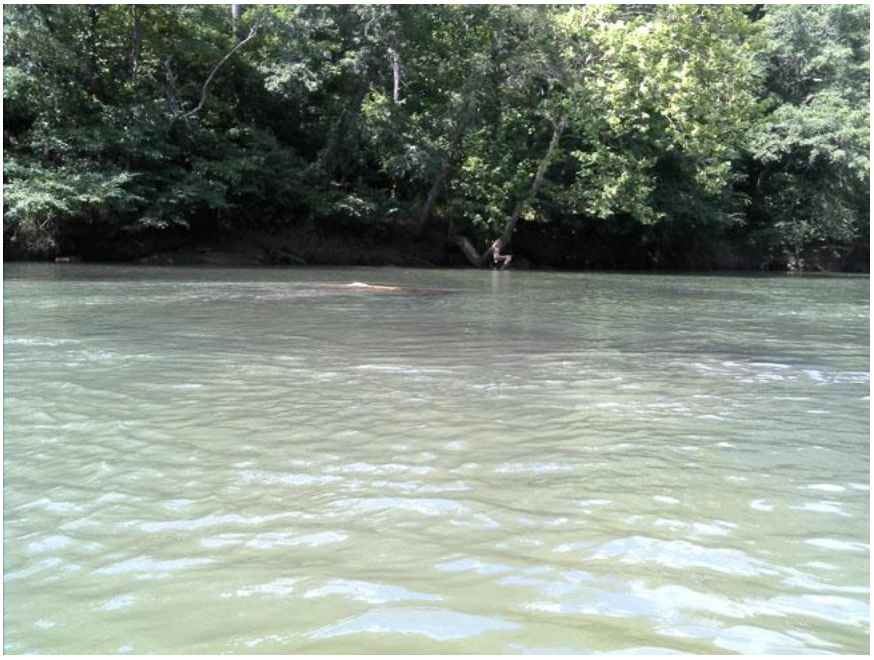
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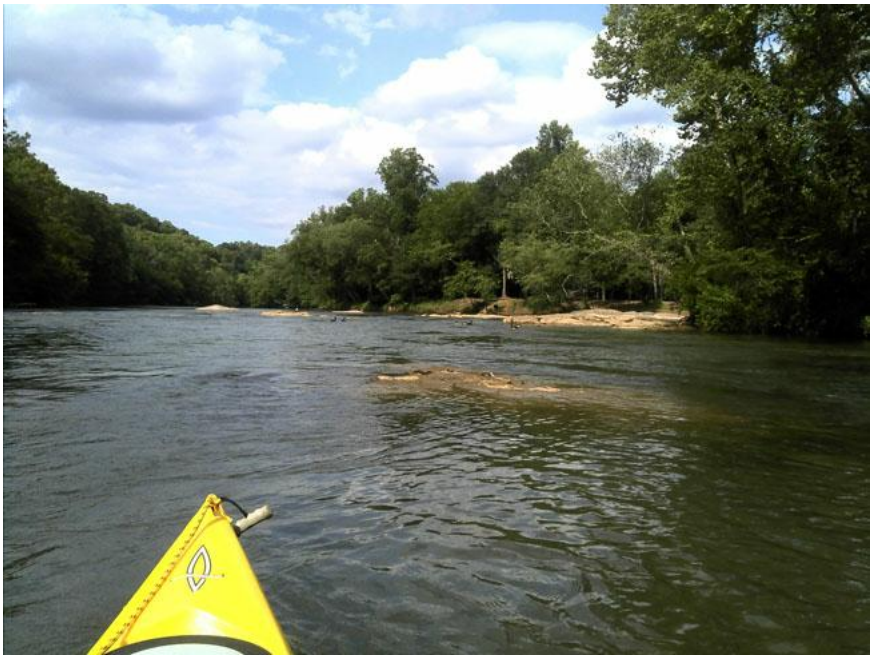
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Photograph DSC00125



Photograph DSC00126



Photograph DSC00127



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Photograph DSC00134



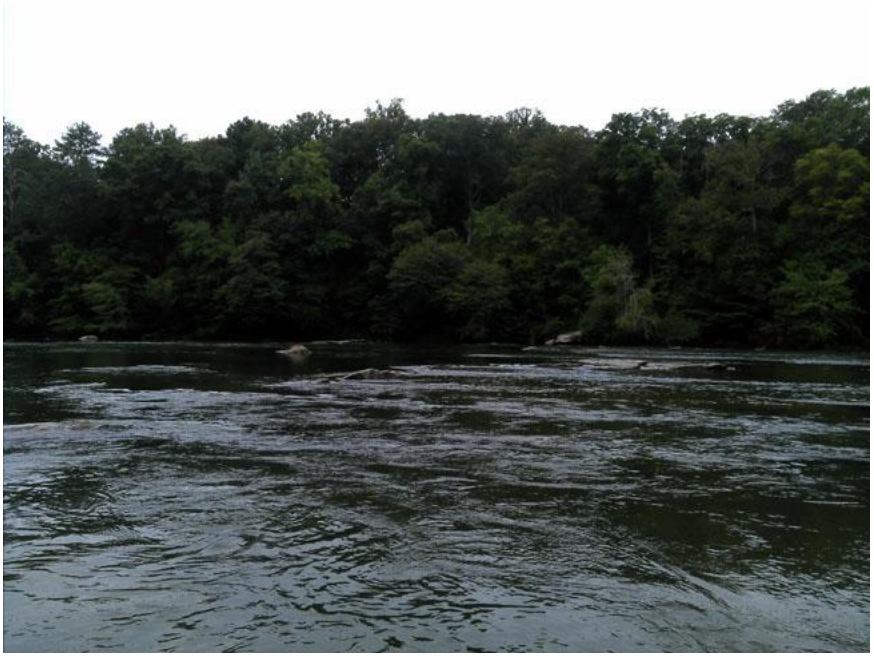
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Photograph DSC00140



Photograph DSC00141



Photograph DSC00142



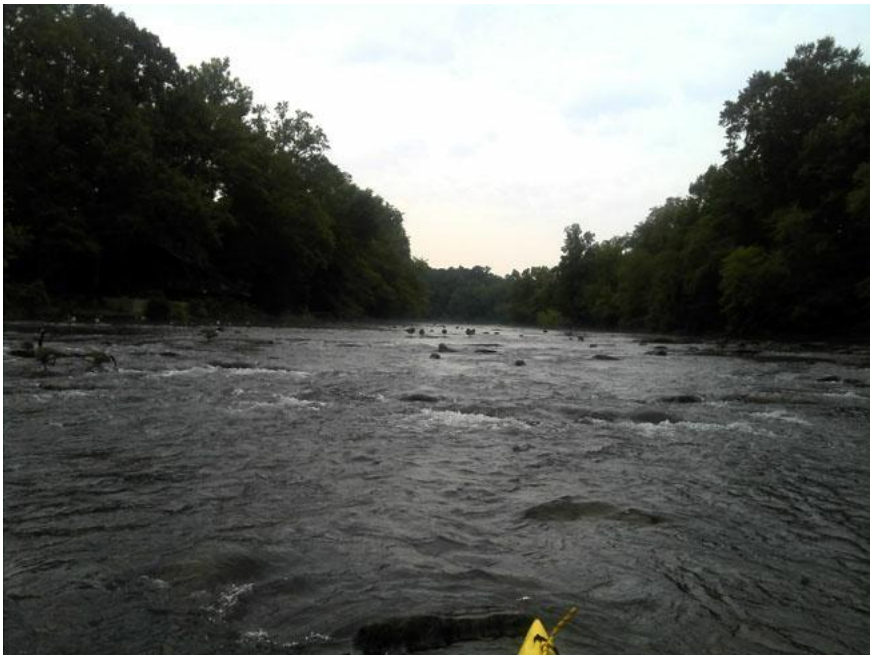
Photograph DSC00143



Photograph DSC00144



Photograph DSC00145



Photograph DSC00146



Photograph DSC00147



Photograph DSC00148



Photograph DSC00149



Photograph DSC00150



Photograph DSC00151



Photograph DSC00152



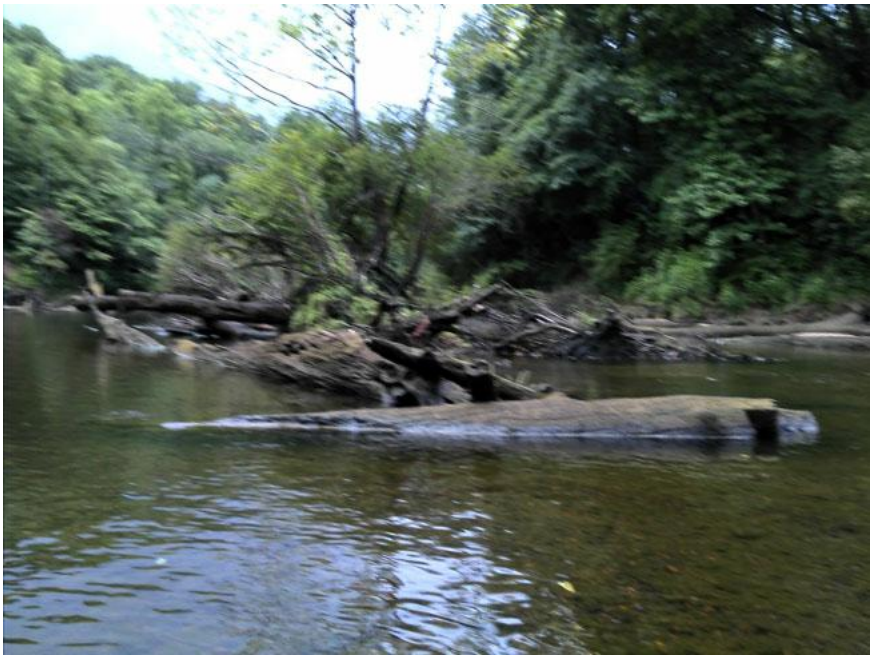
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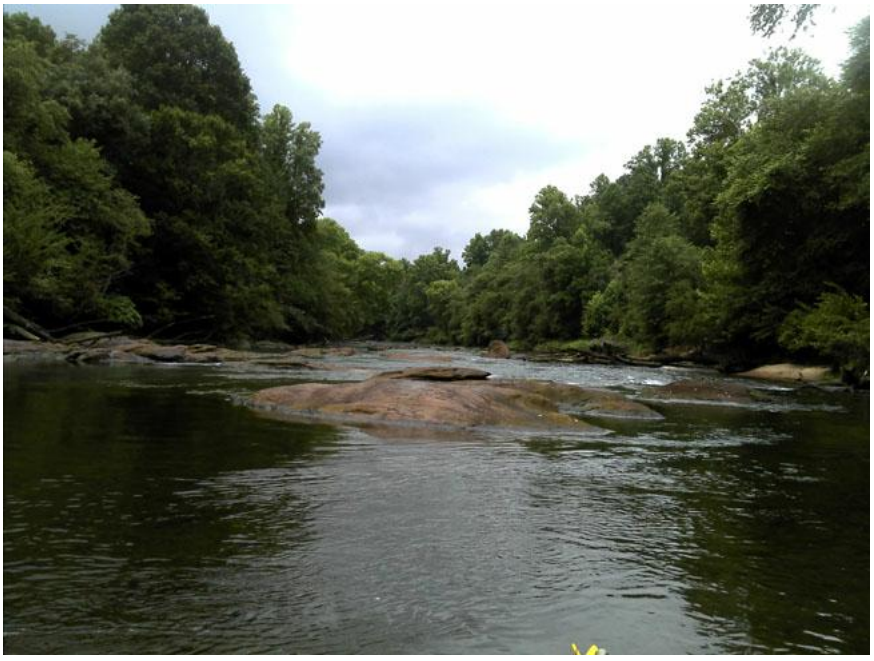
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Photograph DSC00155



Photograph DSC00156



Photograph DSC00157



Photograph DSC00158



Photograph DSC00159



Photograph DSC00160



Photograph DSC00161



Photograph DSC00162



Photograph DSC00163



Photograph DSC00164



Photograph DSC00165



Photograph DSC00166



Photograph DSC00167



Photograph DSC00168



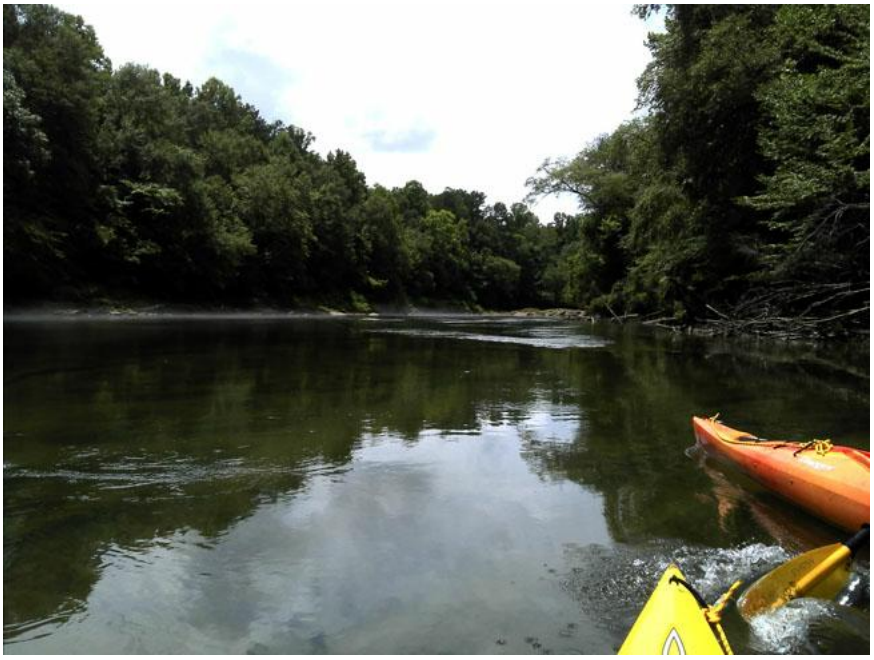
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Photograph DSC00170



Photograph DSC00171



Photograph DSC00172



Photograph DSC00173



Photograph DSC00174



Photograph DSC00175



Photograph DSC00177



Photograph DSC00178



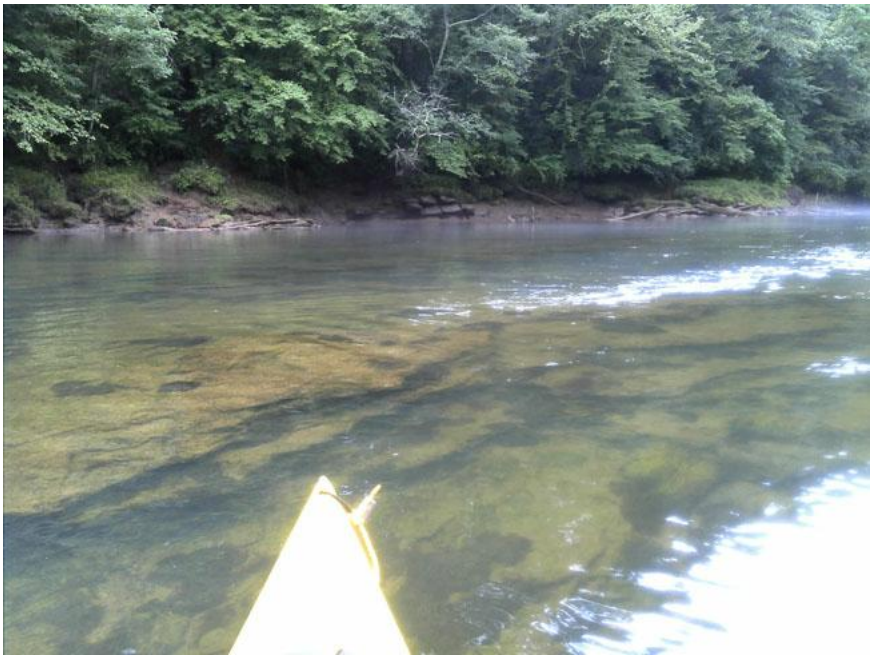
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Photograph DSC00180



Photograph DSC00181



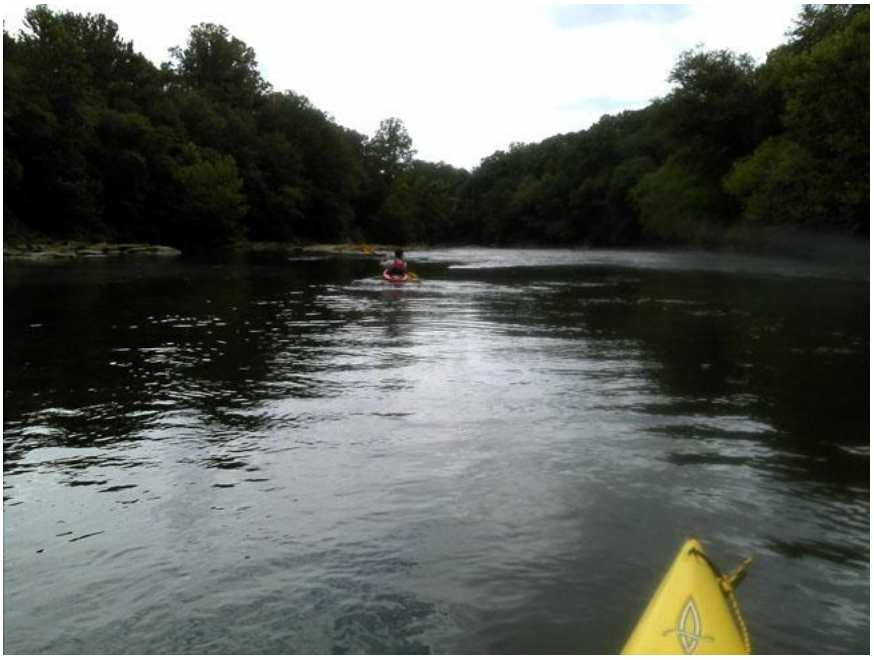
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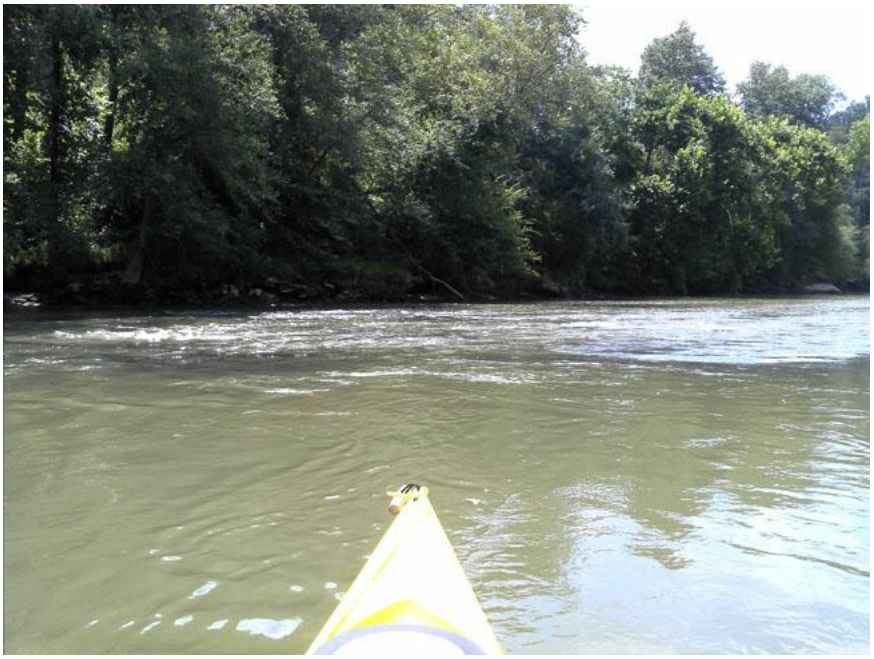
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Photograph DSC00184



Photograph DSC00185



Photograph DSC00186



Photograph DSC00187



Photograph DSC00189



Photograph DSC00190



Photograph DSC00191



Photograph DSC00192



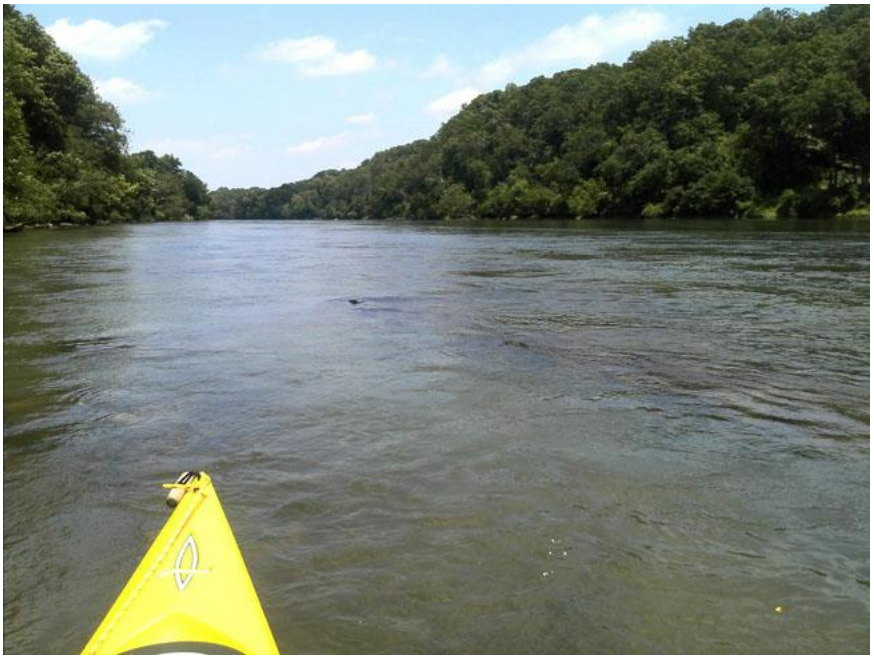
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Photograph DSC00194



Photograph DSC00195



Photograph DSC00196



Photograph DSC00197



Photograph DSC00198



Photograph DSC00199



Photograph DSC00200



Photograph DSC00201



Photograph DSC00202



Photograph DSC00203



Photograph DSC00204



Photograph DSC00205



Photograph DSC00206



Photograph DSC00207



Photograph DSC00208



Photograph DSC00209



Photograph DSC00210



Photograph DSC00211



Photograph DSC00212



Photograph DSC00213



Photograph DSC00214



Photograph DSC00215



Photograph DSC00216



Photograph DSC00217



Photograph DSC00218



Photograph DSC00219



Photograph DSC00220



Photograph DSC00221



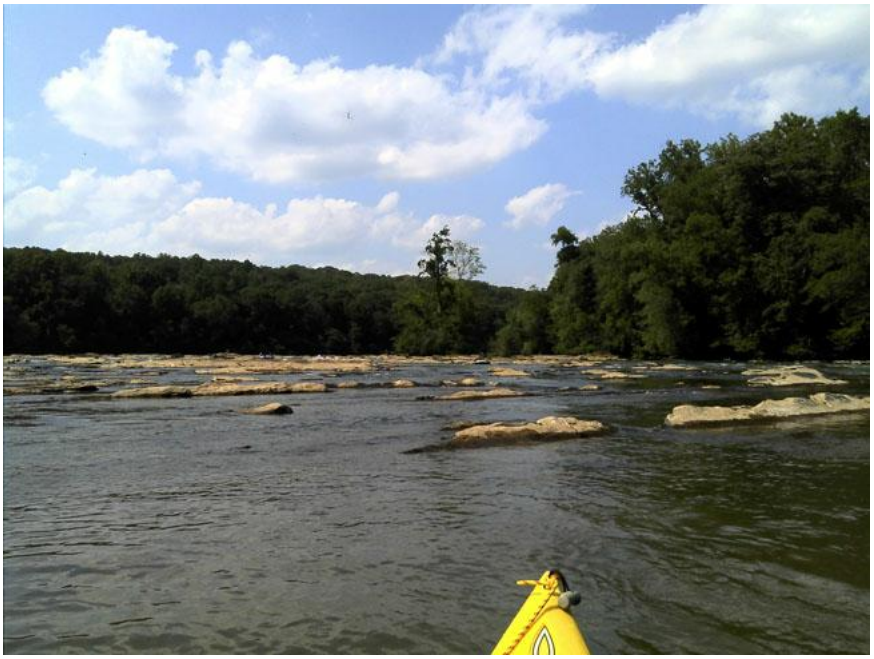
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Photograph DSC00223



Photograph DSC00224



Photograph DSC00225



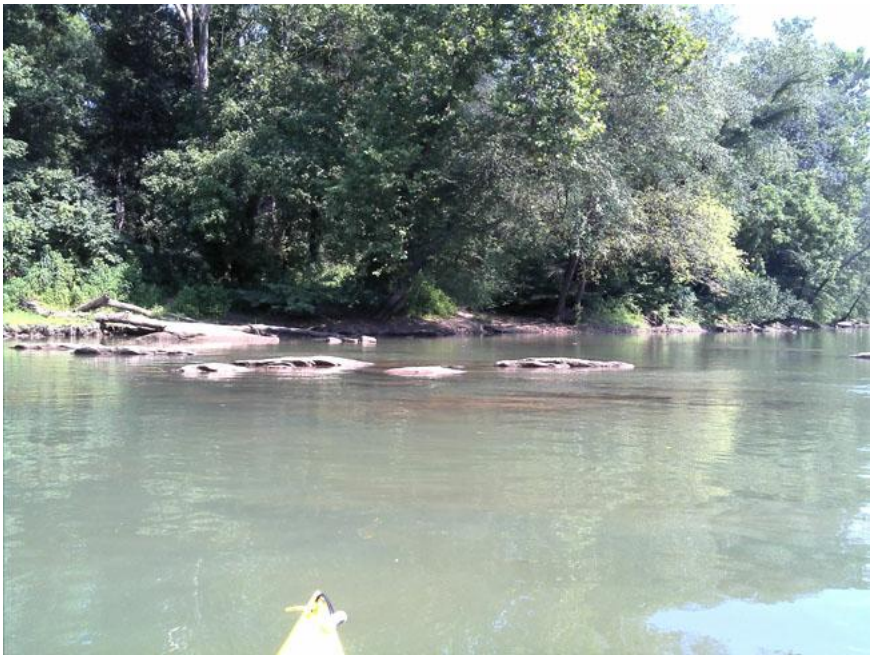
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Photograph DSC00227



Photograph DSC00228



Photograph DSC00229



Photograph DSC00230



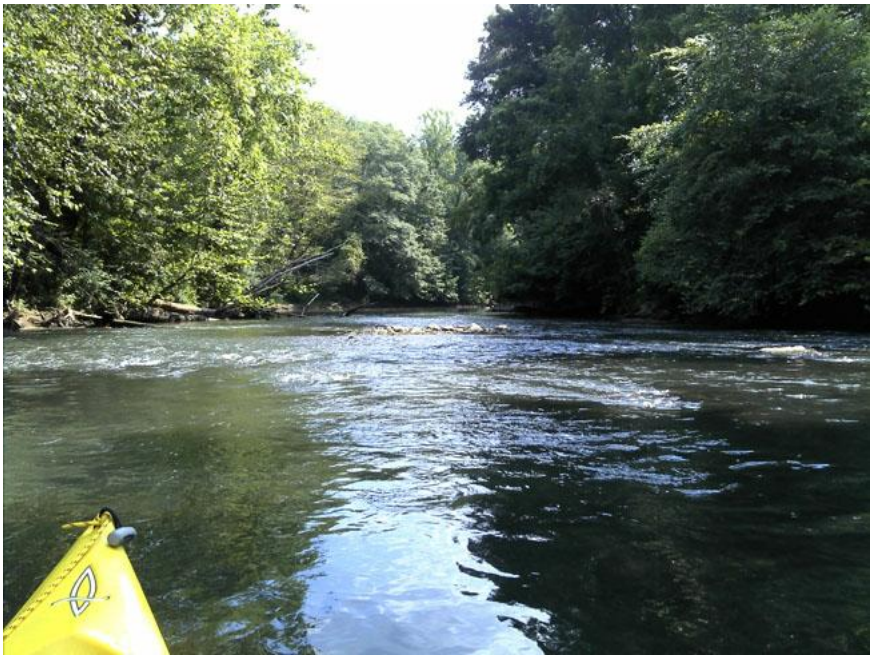
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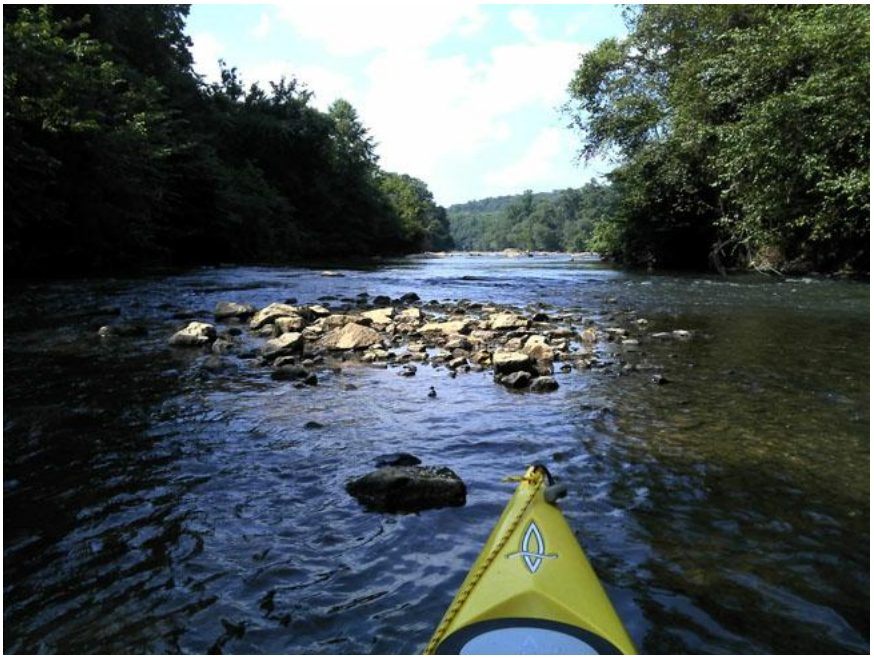
Photograph DSC00232



Photograph DSC00233



Photograph DSC00234



Photograph DSC00235



Photograph DSC00236



Photograph DSC00237



Photograph DSC00238



Photograph DSC00240



Photograph DSC00241



Photograph DSC00242



Photograph DSC00243



Photograph DSC00244



Photograph DSC00245



Photograph DSC00246



Photograph DSC00247



Photograph DSC00248



Photograph DSC00249



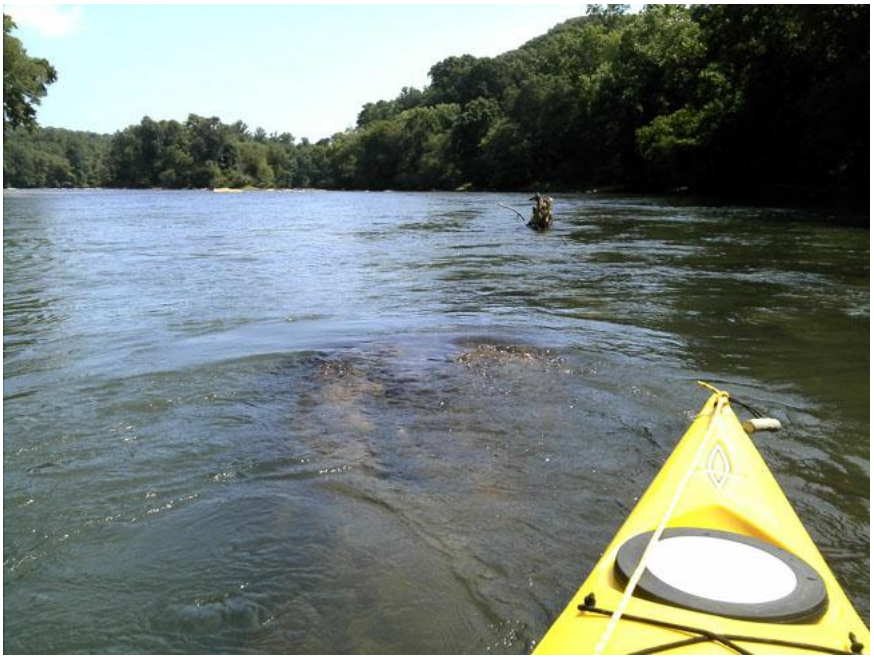
Photograph DSC00250



Photograph DSC00251



Photograph DSC00252



Photograph DSC00253



Photograph DSC00254



Photograph DSC00255



Photograph DSC00256



Photograph DSC00257



Photograph DSC00259



Photograph DSC00260



Photograph DSC00261



Photograph DSC00262



Photograph DSC00263



Photograph DSC00264



Photograph DSC00265



Photograph DSC00266



Photograph DSC00267



Photograph DSC00268



Photograph DSC00269



Photograph DSC00270



Photograph DSC00271



Photograph DSC00272



Photograph DSC00273



Ancillary Information

The following section presents ancillary source map information associated with the GeoCorps of America unpublished Shoals and Underwater Hazards Map (Chattahoochee NRA) source map.

GeoCorps of America unpublished Shoals and Water Hazards Map (Chattahoochee NRA)

The formal citation for this source.

Hundley, Jeffrey Britton, 2014, Shoals Map of Chattahoochee River National Recreation Area, Georgia: GeoCorps of America, unpublished map, scale 1:24,000 (*GRI Source Map ID 76002*).

Prominent text associated with this source map:

Data Collection Information

GPS Locations and georeferenced images (photographs) collected using a Garmin GPSmap 62stc. Map Datum/Spheroid: WGS 84

Water flow conditions, start and end points, and waypoints and photographs (images) taken are listed for each day of data collection.

Date: Sunday, 7/13/2014
Flow Conditions: USGS Gauge #02334653 reports ~630cfs
Start: Settles Bridge (mi 344)
End: Abbotts Bridge (mi 355)
Waypoints: 001 - 045
Images: DSC00001.jpg - DSC00051.jpg

Date: Monday, 7/14/2014
Flow Conditions: USGS Gauge #02334653 reports ~680cfs
Start: Abbots Bridge (mi 355)
End: Jones Bridge (mi 329)
Waypoints: 046 - 068
Images: DSC00052.jpg - DSC00076.jpg

Date: Tuesday, 7/15/2014
Flow Conditions: USGS Gauge #02335000 reports ~800cfs
Start: Jones Bridge Park (mi 329)
End: Island Ford (mi 320)
Waypoints: 069 - 125
Images: DSC00077.jpg - DSC00134.jpg

Date: Friday, 7/18/2014
Flow Conditions: USGS Gauge #02335450 reports ~890cfs
Start: Island Ford (mi 320)
End: Morgan Falls (mi 313)
Waypoints: 126 - 137
Images: DSC00135.jpg - DSC00147.jpg

Date: Tuesday, 7/22/2014
Flow Conditions: USGS Gauge #02334430 reports ~629cfs
Start: Buford Dam (mi 348)
End: Settles Bridge (mi 344)
Waypoints: 138 -172
Images: DSC00148.jpg - DSC00184.jpg

Date: Sunday, 7/27/2014
Flow Conditions: USGS Gauge #02335815 reports ~1060cfs
Start: Morgan Falls (mi 312)
End: Paces Mill (mi 304)
Waypoints: 173 - 234
I**Images:** DSC00185.jpg - DSC00251.jpg

Date: Monday, 7/28/2014
Flow Conditions: USGS Gauge #02336000 reports ~1010cfs
Start: Paces Mill (mi 304)
End: Stamps Sand Company (mi 300)
Waypoints: 234 - 255
Images: DSC00252.jpg - DSC00273.jpg

Text from source map: GeoCorps of America unpublished Shoals and Underwater Hazards Map (Chattahoochee NRA)

Source Metadata Information

Image (Photograph) Locations (Geologic Observation Localities in the GRI digital GIS data):

Summary

Locations of images taken of shoal hazards. Correlates with shoal locations in Waypoints.shp

Description

Point data representing the location of the camera or focal point at the time the image was taken. The symbology indicates the location of the camera with the circular point. The azimuthal direction the camera was facing (ie. upstream/downstream) is indicated by the line or tail coming off of the point.

Credits

Data collected by Jeffrey Britton Hundley, Jr. with assistance from Israel Blue Phillips.
Under the supervision of Bruce Heise and Paula Capece of the National Park Service.
Part of the Geological Society of America GeoCorps Program.

Use limitations

Exclusively for scientific research purposes.

Extent

West -84.460485
East -84.076551
North 34.158059
South 33.824872

Scale Range

Maximum (zoomed in) 1:5,000
Minimum (zoomed out) 1:500,000

Shallow Subsurface Hazards (Underwater Hazard Area Features in the GRI digital GIS data):

Summary

Polygonal representation of shallow hazard zones.

Description

Areas of shallow water hazards such as point bars or mid-channel bars. Including shallow sand or gravel bars. Not hard rock shoals, but an accumulation of sediments causing hazardous shallow areas.

Credits

Data collected by Jeffrey Britton Hundley, Jr. with assistance from Israel Blue Phillips.
Under the supervision of Bruce Heise and Paula Capece of the National Park Service.
Part of the Geological Society of America GeoCorps Program.

Use limitations

Data exclusively for scientific research purposes. Not to be used for navigation, depths to shoals may

vary with flow conditions and location.

Extent

West -84.438590
East -84.101356
North 34.109535
South 33.919483

Scale Range

Maximum (zoomed in) 1:5,000
Minimum (zoomed out) 1:500,000

Shoal Areas (Shoal Area Features in the GRI digital GIS data):

Summary

Polygonal representation of shoal locations or zones.

Description

Polygonal data of concentrated shoal areas derived from field notes supplemented by aerial photography and satellite imagery.

Credits

Data collected by Jeffrey Britton Hundley, Jr. with assistance from Israel Blue Phillips.
Under the supervision of Bruce Heise and Paula Capece of the National Park Service.
Part of the Geological Society of America GeoCorps Program.

Use limitations

Data exclusively for scientific research purposes. Not to be used for navigation, depths to shoals may vary with flow conditions and location.

Extent

West -84.461279
East -84.075634
North 34.159163
South 33.824568

Scale Range

Maximum (zoomed in) 1:5,000
Minimum (zoomed out) 1:500,000

Text form source map: GeoCorps of America unpublished Shoals and Underwater Hazards Map (Chattahoochee NRA)

Study Area (Map Boundary in the Shoal Area Feature Boundaries in the GRI digital GIS data):

Summary

Rough outline of park boundaries around the Chattahoochee River from Buford Dam to Peachtree Creek. General study area.

Description

There is no description for this item.

Credits

Jeffrey Britton Hundley, Jr.

Use limitations

General extent of study area, not exact boundary of Chattahoochee National Park and Recreation Center.

Extent

West -84.503745
East -84.058619
North 34.170646
South 33.800829

Scale Range

Maximum (zoomed in) 1:5,000
Minimum (zoomed out) 1:500,000

Waypoints (Geologic Observation Localities in the GRI digital GIS data):

Summary

Map of shoal locations on the Chattahoochee River within the National Park Service Chattahoochee National Park and Recreation Center. Explicitly for scientific research documenting present shoal locations.

Description

GPS location data of shoals, rapids, or underwater hazards within the bounds of the National Park Service Chattahoochee National Park and Recreation Center. This data encompasses 56 miles of the Chattahoochee River through the North Atlanta area from the Buford Dam at Lake Sidney Lanier in the north down to the input of Peachtree Creek to the south. The collection of this data was the target of an Geological Society of America GeoCorps Internship Program in colaboration with the National Park Service program "Geoscientists in the Parks" in the summer of 2014.

Credits

Data collected by Jeffrey Britton Hundley, Jr. with assistance from Israel Blue Phillips.
Under the supervision of Bruce Heise and Paula Capece of the National Park Service.
Part of the Geological Society of America GeoCorps Program.

Use limitations

Data exclusively for scientific research purposes. Not to be used for navigation, depths to shoals may vary with flow conditions and location.

Extent

West -84.460177
East -84.076117

North 34.157943
South 33.824895

Scale Range

Maximum (zoomed in) 1:5,000
Minimum (zoomed out) 1:500,000

Text from source map: GeoCorps of America unpublished Shoals and Underwater Hazards Map (Chattahoochee NRA)

GRI Digital Data Credits

This document was developed and completed by Stephanie O'Meara (Colorado State University) for the NPS Geologic Resources Division (GRD) Geologic Resources Inventory (GRI) Program. Quality control of this document by Jim Chappell (Colorado State University).

The information in this document was compiled from the GRI source map, and intended to accompany the digital geologic-GIS map and other digital data for Chattahoochee River National Recreation Area, Georgia (CHAT) developed by Stephanie O'Meara (Colorado State University) (see the GRI Digital Maps and Source Map Citations section of this document for all sources used by the GRI in the completion of this document and related GRI digital geologic-GIS maps).

GRI finalization by Stephanie O'Meara.

GRI program coordination and scoping provided by Bruce Heise, Tim Connors and Jason Kenworthy (NPS GRD, Lakewood, Colorado).