Berry Limestone: An informal formation, introduced to rationalize Mississippian stratigraphy in the Floyd Synclinorium of northwest Georgia

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ABSTRACT

Geologic maps of Hayes (1902) and Butts (1948) show that most of the Mississippian System in Floyd and Chattooga Counties, Georgia, consists of dark-gray silty shale assigned to the Floyd Shale. Cressler (1970) recognized the presence of a thick basal limestone associated with the Floyd Shale, and recent detailed mapping shows this limestone, informally called the Berry Limestone, can be mapped nearly continuously through most of Floyd County and parts of Chattooga County. The Berry varies in thickness between about 150m on the campus of Berry College to more than 300m near Gore, Georgia. Coring near Gore indicates a motif of shallowing-upward parasequences commencing with shaly or cherty skeletal wackestones at the base, grading up into crinoidal packstones and ooid grainstones. Based on foraminiferal zonation (Rich, 1982; 1983), this limestone correlates with the Tuscumbia and Monteagle limestones of the Cumberland Plateau.

We suggest retaining the name Floyd to include clastic facies, both shales and sandstones that separate lower- from upper-Mississippian limestones, Berry and Bangor, respectively. This usage removes the name Hartselle Sandstone from the stratigraphic sequence in NW Georgia as recommended by Thomas (1979).

Mapping of the Berry Limestone allows increased stratigraphic control that aids in the delineation of several structural features, in particular, thrust faults on the northwest limbs of Simms, Turkey and Lavender Mountain anticlines. Furthermore, Mississippian limestone (formerly mapped as Conasauga Group) extends much further north along the axis of the Horseleg Mountain anticline than previously mapped. This anticline is completely surrounded by imbricates of Conasauga shale that appear to be associated with the Rome Fault, except in one small area where the Rome Formation (Coosa Fault) rests directly on the Berry. This structural relationship suggests that the Rome Fault predates the Coosa Fault.

1 Berry Campus (type section)-

The Berry Limestone is named for outcrops on the campus of Berry College, Rome, Georgia. It was particularly well exposed in the old Ledbetter quarry, mined by Florida Rock up until 2000. It was described by Rich (1982) as the lower Floyd and estimated to be around 500 feet thick. Lithologies include interbedded ooidal and skeletal (crinoid-bryozoan) limestones with lesser shaly and dolomitic limestones. Some beds are spiculitic and contain chert as nodules and irregular seams. It is overlain at the quarry by dark gray calcareous shale assigned to the middle member of the Floyd. Some limestone is present in this member but shale predominates. The name Floyd is retained for the middle and upper parts of the section up to the base of the Bangor Limestone. This interval is dominated by clastics with black shale giving way to sandstones in the upper part.

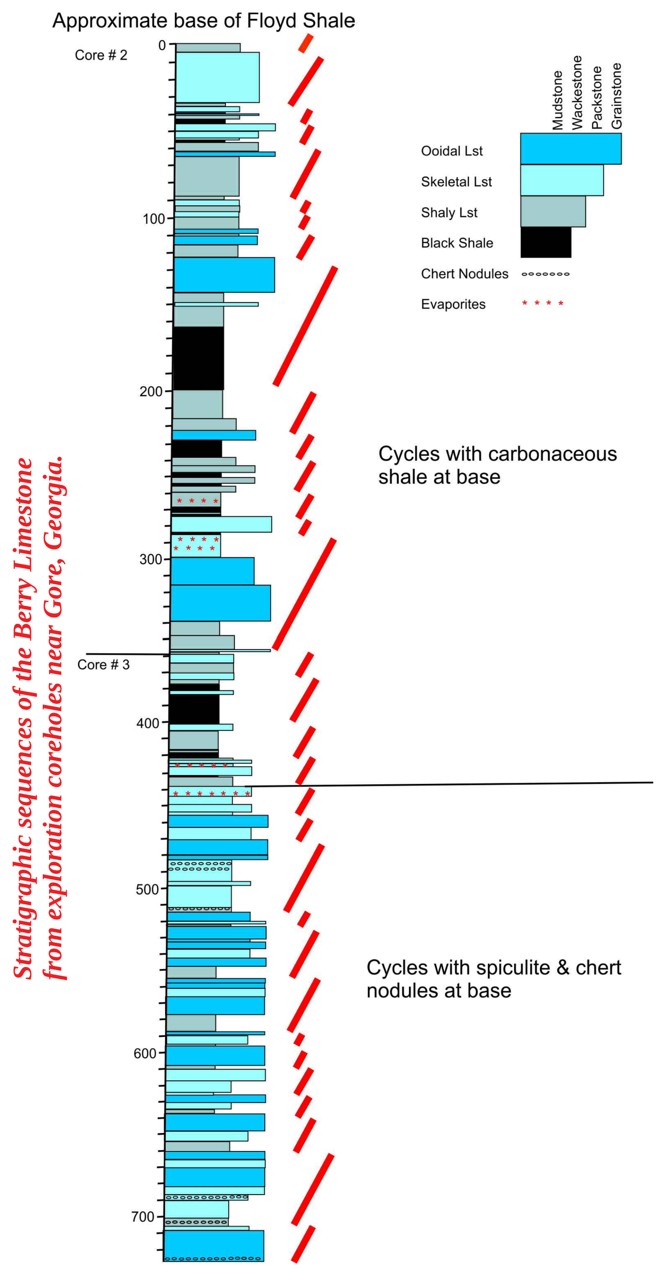
Estimates of thickness for the Floyd are based on core obtained during construction of the Rock Mountain pumped storage project (Grainger, 1974). The composite section is as follows:

Floyd sandstones (formerly mapped as Hartselle Sandstone)	60' (18 m)
Floyd shale (includes some limestone in lower part)	900' (274 m)
Berry Limestone	500' (152 m)
Lavender Shale Member of Fort Payne Chert	250' (76 m)
Total	1710' (521 m)

The contacts between formations are facies changes and thicknesses are therefore expected to vary from locality to locality.

2 Gore-

Geologic mapping indicates 330 m (1090 ft) of thick bedded limestone between the Fort Payne Chert and Floyd Shale. This limestone probably correlates with the Tuscumbia and Monteagle limestones of the Cumberland Plateau (Rich, 1982, 1983) and is informally recognized as the Berry Limestone (for exposures on the campus of Berry College, in Rome). The upper 222m (730 ft) has been cored and shows a sequence of shallowing-upward cycles (3-23m thick). In the lower part (see figure) cycles consist of cherty mudstones and wackestones grading up into skeletal packstones and ooid grainstones while in the upper part cycles begin with black shales and shaly wackestones. Each cycle is interpreted to be initiated by a flooding surface with high energy shelf carbonates prograding over lower energy basinal carbonates and black shales. A few cycles are capped by light gray mudstones with coral or bryozoan bioherms and pseudomorphs after evaporite nodules, suggestive of lagoonal environments shoreward of the ooid shoals. The basinal black shales are evidently fingers of the Floyd Shale facies.



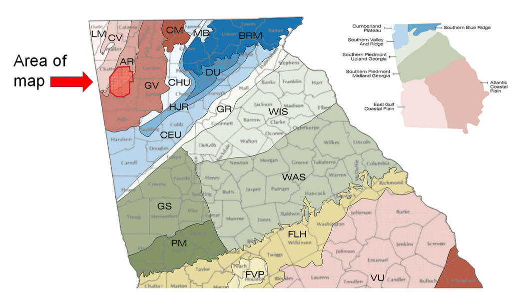
Stratigraphic sequences of the Berry Limestone from exploration coreholes near Gore, Georgia.

3 Simms Mountain-

Simms Mountain Anticline is part of an ENE trending fold train formed by interference with older NNE striking structures like Johns Mountain. Whereas Johns Mountain marks the frontal ramp of the Clinchport thrust sheet, Simms Mountain arises from a previously unmapped Simms Mountain Fault. Absence of the Berry Limestone in the footwall is critical to the mapping of the Simms Mountain Fault.

The Clinchport Fault ramps up-section from the north and plunges to the south, while the Simms Mountain Fault ramps-up section from the southwest and plunges to the northeast. The two folds interfere near Crystal Springs and the Clinchport Fault is displaced by the Simms Mountain Fault. The Simms Mountain Fault probably rises from the Conasauga decollement in the southwest, ramps up through the Knox Group, and flattens out in Mississippian strata. Where it crosses Middle Ordovician-Devonian strata the fault appears to involve several lenticular horses.

Georgia Physiographic Provinces



USGS 7.5-Minute Quadrangle Index

S'ville	Armuchee	Plainville
Rock Mtn	Rome North	Shannon
Livingston	Rome South	

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Numerous individual landowners in the Rome and Summerville area.

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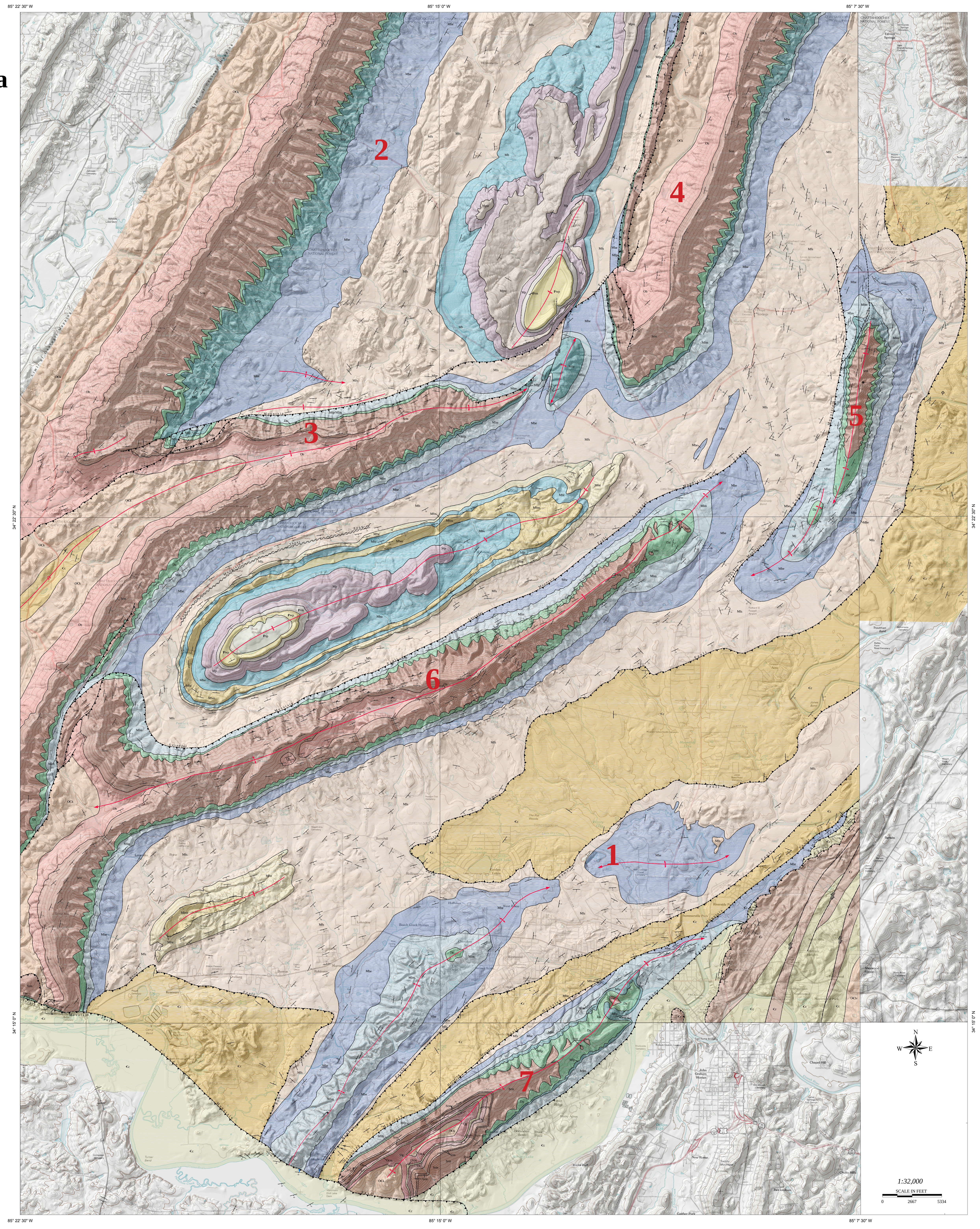
Coordinate System: UTM27-16



EXPLANATION OF MAP UNITS

Psp SIGNAL POINT SHALE (PENNSYLVANIAN) - Dark gray shale and silty shale, with flaser bedding. Locally, it contains appreciable interbedded siltstone and thin bedded sandstone. Estimated thickness- 250 feet.

Pwp WARREN POINT SANDSTONE (PENNSYLVANIAN) - Medium- to coarse-grained sandstones, and conglomeratic sandstones. There are extensive lenses of quartz-pebble conglomerate in both the lower and upper parts. Estimated thickness- 125 feet.

Prm RACOON MOUNTAIN FORMATION (PENNSYLVANIAN) - Interbedded shale, siltstone, and fine- to medium-grained sandstone. Siderite nodules are common in the gray shales; flaser bedding is pervasive in the shale and siltstone; and shale clasts are common in the thin bedded sandstones. Estimated thickness- 175 feet.

Mp PENNINGTON FORMATION (UPPER MISSISSIPPIAN) - Dark gray, silty shale and siltstone. Laterally, the shale and siltstone intertongue with sandstone, which is generally fine- to medium-grained, thin- to medium-bedded and commonly cross bedded (planar). These sandstones vary in importance locally and are usually lenticular, and 10 to 25 feet thick, but in places they are more than 100 feet thick. Massive beds of quartz-pebble conglomerate, several tens of feet thick, are common. Estimated thickness- 650 feet.

Mpst PENNINGTON SANDSTONE (UPPER MISSISSIPPIAN) - Sandstone unit within Pennington is generally fine- to medium-grained, thin-to-medium bedded and commonly crossbedded (planar). This sandstone is usually lenticular, and 10 to 25 feet thick, but in places can be more than 100 feet thick. Massive beds of quartz-pebble conglomerate, several tens of feet thick, are common in this unit. Mapped separately from balance of Pennington on Little Sand Mountain.

Mb BANGOR (undifferentiated, UPPER MISSISSIPPIAN) - In the Rock Mountain syncline, the Bangor was cored and described in sufficient detail to map it as three distinct sub-units. In Chattooga County, the Bangor has a similar stratigraphic sequence as at Rock Mountain, but on a smaller scale. Differentiating these for mapping purposes was impractical, thus the Bangor was mapped as an undifferentiated unit - which is mostly a thick to massively bedded blue-gray fine- to coarse-grained limestone with intertonguing sandstone and shale beds. Estimated thickness- 400 to 650 feet.

Mbu BANGOR (upper member, UPPER MISSISSIPPIAN) - Bluish gray, fine- to coarse-grained limestone, fossiliferous with abundant crinoid fragments. Mostly massive with occasional calcareous shale and argillaceous limestone beds. Estimated thickness- 250 feet.

Mbm BANGOR (middle member, UPPER MISSISSIPPIAN) - Dark gray to black silty shale with numerous thin closely-spaced sandstone laminations. Occasional flaggy sandstones with locally thick bedded lenses up to 20 feet. Overlying soils over weathered outcrop are covered with sandstone blocks 1"-24" thick. Upper beds are increasingly calcareous and interbedded with thin limestones. At Judy Mountain, the sandstones of the middle Bangor appear to explain the thickened sandstone sequence observed there. (the limestone unit of the lower Bangor was not observed at Judy Mountain). Estimated thickness- 200 feet.

Mbl BANGOR (lower member, UPPER MISSISSIPPIAN) - Thickly bedded gray fine to coarsely crinoidal grainstone with interbedded fossiliferous argillaceous limestone or mudstones. Fossils: corals and bryozoans common locally. Estimated thickness- 200 feet.

Mfst FLOYD SANDSTONE (upper member, UPPER MISSISSIPPIAN) - In Floyd County, the Floyd Shale sequence is capped by a mostly thin-bedded gray sandstone, interbedded with thin dark shale partings. Sandstone is locally calcareous and weathers to sandy orange soil leaving many thin pieces of fine sandstone. Thick-bedded sandstones - in sections 5'- 15' thick - emerge locally with hard, vitreous quartz matrix, resulting in thickening of the unit and steepened topography. In Chattooga County, similar sandstones interbedded at multiple horizons within the Floyd Shale and were not mappably distinguishable from the balance of the Floyd Shale. Estimated thickness- 50 to 100 feet.

Mfs FLOYD SHALE (UPPER MISSISSIPPIAN) - Mainly shale, dark gray to black, with mm-scale lamination; interbedded with siltstone, fine-grained sandstone, and thin limestones; contains fossiliferous concretions. Weathers pale gray to tan. Many close-spaced joints combined with thin bedding yield residuum of small shale/siltstone/sandstone fragments in a light-colored soil. Beds in lower half are calcareous, silty, and slabby; in upper half predominately clay shale with interbedded, thin fine sandstones increasing towards top. In Chattooga County, the shale is interbedded with locally thick-bedded sandstones throughout the sequence. Estimated thickness- 500 to 1200 feet.

Mbe BERRY LIMESTONE (UPPER MISSISSIPPIAN) - Limestone and shaly limestone; gray, fine to coarsely crinoidal/bryozoan, interbedded with oolite; lower half includes beds of ropy 1"-3" (thick) fossiliferous black chert and occasional chert nodules. Weathering produces a distinctive, reddish, clay-rich soil, locally cherty, with abundant fragments of small (< 1/4") crinoid stem plates, brachiopods, and solitary rugose corals. Estimated thickness- 500 to 1000 feet.

Mlm FORT PAYNE CHERT, LAVENDER SHALE MEMBER (LOWER MISSISSIPPIAN) - Calcareous shale and argillaceous carbonate of varying dolomite content. Fresh surfaces are dark greenish gray to dark gray. Due to carbonate content, weathers readily to tan colored shaly saprolite sometimes with distinctive light green or purplish clay. Bedding ranges from a few inches to a few feet. Locally contains silicified geodes 1"- 4" diameter. Lower beds include an increasing frequency of thin silty chert beds and grade into cherty facies of the Fort Payne On the north side of mountain, upper beds include highly fossiliferous greenish shaly limestone with many bivalves and fenestrate bryozoans. Estimated thickness- 0 to 250 feet.

Mfp FORT PAYNE CHERT (LOWER MISSISSIPPIAN) - Dark gray evenly spaced chert beds 1"-12" thick with thin greenish to gray shale partings, weathering readily to jointed light gray or white chert. Silty argillaceous chert beds common in facies transition to Lavender Member (above). Yields a blocky residuum in light colored soil. Small silicified geodes locally common. Mostly unfossiliferous, but locally, calcareous beds toward the top contain molds of 1/2" crinoid stems. Includes thin Maury Shale (1-2') at base; a greenish gray clay shale with conspicuous phosphatic nodules. Estimated thickness- 0 to 200 feet.

Da CHATTANOOGA SHALE (UPPER DEVONIAN) - Shale, black, carbonaceous, fissile. Estimated thickness- 10 to 20 feet.

ARMUCHEE CHERT (LOWER DEVONIAN) - Chert interbedded with sandstone (Frog Mountain facies). Beds range from 3" to 24" thick. Bedding surfaces and thickness notably more irregular than the relatively even-bedded Fort Payne chert. Estimated thickness- 60 to 80 feet.

Srm RED MOUNTAIN FORMATION (LOWER SILURIAN) -Interbedded gray (tan weathering) to moderate reddish shale and siltstone interbedded with coarse grained hematitic sandstone. Sandstones form the crest of most of the major ridges in the map area: Horseleg, Lavender, Johns, Simms, Turkey mountains and Taylor Ridge. Estimated thickness- 900 to 1200 feet.

Ob BAYS FORMATION (MIDDLE-UPPER ORDOVICIAN) - Where the Colvin Mountain sandstone unit is either missing or too thin to map, all of the Middle and Upper Ordovician beds were mapped as Bays Formation undifferentiated. These are comprised of mostly shaly redbeds and sandstones with increasing carbonate content toward the bottom half. Chickamauga limestone interbeds are significant in the lower third of the map unit on the western slopes of Taylor Ridge, but were not mapped separately from the Bays. Estimated thickness- 600 to 1000 feet.

Os SEQUATCHIE FORMATION (MIDDLE-UPPER ORDOVICIAN) - Gray and red shales, siltstones, and fine laminated sandstones. Interbedded with occasional light gray medium to coarse quartz arenites, which vary in thickness locally. Some gray and reddish carbonates interbedded on the west slope of Taylor Ridge. Estimated thickness- 250 feet.

Ocm COLVIN MOUNTAIN SANDSTONE (MIDDLE-UPPER ORDOVICIAN) - Massive, very light gray, fine to medium grained quartz arenite containing some large grains. Quartz cemented, hard, vitreous. Turns yellowish when weathered. Associated with T4 bentonite at Horseleg Mtn. The sandstone appears to exist at Lavender, Johns and Simms Mountains, but is too thin to map. Estimated thickness- 0 to 40 feet.

Og GREENSPORT FORMATION (MIDDLE-UPPER ORDOVICIAN) - Gray and red shales, siltstones, and sandstones interbedded with carbonates, particularly northwest of Horseleg Mountain. Locally, bottom of formation contains variable amounts of transitional beds on top of karst topography of the Knox unconformity - including chert conglomerates (i.e., Attalla) and other local conglomeratic shaly limestones and mudstones. Estimated thickness- 350 feet.

O€k KNOX GROUP (undifferentiated, UPPER CAMBRIAN - LOWER ORDOVICIAN) - Thin to massive-bedded dolostone, mainly brown or tan in the lower part and medium to light-gray in the middle and upper parts. Gray limestone beds are interlayered with the dolostone in the upper part. The dolostone is highly siliceous and produces a cherty, silty clay residuum that generally blankets the hilly outcrop with 25-200 feet of residuum. Outcrop belt includes Copper Ridge Dolomite, Chepultepec Dolomite, and Longview Limestone units. Estimated thickness up to 2000 feet in the mapped area.

€c CONASAUGA FORMATION (MIDDLE CAMBRIAN) - Upper: Mostly olive-gray and tan shale interbedded with locally thick sections of massively bedded, blue-gray ribboned limestone and some gray dolomite; Middle: Mostly massive bedded medium to dark-gray limestone, interlayered with varying thicknesses of olive-gray and tan shale. Some of the limestone is moderately pure and produces a deep red soil, but most contains a large amount of silt and clay that remains as a tan shale residuum; Lower: Shale is gray to black, silty in part, and weathers buff pink, and brown. Limestone is very fine-grained, lithographic in places; weathers nearly white. Cut by ramifying network of calcite-filled fractures. Contains paper-thin discontinuous shale partings thoughout. The limestone is interbedded with shale and occurs as lenses, of all scales, within the shale. Estimated thicknesses unknown.

€r ROME FORMATION (LOWER CAMBRIAN) - Gray silt and clay shale that weathers to tan, orange, pink and maroon and commonly displays a distinctive silver sheen. Some silty shale is dolomitic and in unweathered exposures has the appearance of massive dolostone. Scattered thoughout the shale, and especially in the upper part, are thin to thick layers of gray, purple, white, pale red, and green siltstone and sandstone. Estimated thickness 500 to 900 feet.

EXPLANATION OF MAP SYMBOLS

Formation contact- approximate location
Fault (thrust)- Approximate location; teeth on upper plate.
Fault (strike-slip)- approximate location
Anticlinal fold axis showing plunge direction
Synclinal fold axis showing plunge direction
Overturned Anticlinal fold axis showing plunge direction
Shear zone indicated by slickensides and shear fabrics
25 Strike and Dip of Bedding
65 Strike and Dip of Overturned Bedding
Strike and Dip of Vertical Bedding
Corehole location showing Georgia Geological Survey reference number

4 Johns Mountain-

The Johns Mountain Anticline marks the frontal ramp of the Clinchport Fault. The anticline plunges out to the south where the Clinchport Fault dies out. Like other folds in the Armuchee Ridges the fold is overturned to the west. The Clinchport Fault places the Knox Group at the axis of the anticline on overturned Red Mountain Formation-Fort Payne Chert on the west limb of the fold. In addition, a footwall splay thrusts Fort Payne and Armuchee cherts over Floyd Shale in Haywood Valley. As with the Lavender and Simms Mountain Faults, the Berry Limestone is mainly concealed in the footwall of this splay.

At the south end of Johns Mountain the west limb of the anticline together with the Clinchport Fault and its footwall splay are displaced by the Simms Mountain Fault. This is part of a pattern of fold interference between NNE and ENE striking structures which is evident throughout the area.

5 Turkey Mountain-

A re-examination of core from GGS 3190, on the crest of the Turkey Mountain Anticline, shows that the Red Mountain Formation is repeated as the result of faulting in the Middle Ordovician. Mapping reveals that the Turkey Mountain Fault dips southeast at about 25° parallel to bedding and is most likely a splay off the Rome Fault. It rises from a decollement in the Middle Ordovician (probably controlled by incompetent ash beds) ramps through the Red Mountain, Armuchee, Fort Payne and Berry Limestone formations and flattens out in the incompetent Floyd Shale. Most likely the anticline is part of a horse beneath the Rome Fault.

The Rome Fault is itself folded by the Turkey Mountain Anticline but with less amplitude. It carries Conasauga shale in the hanging wall and Floyd Shale in the footwall and is probably a roof thrust with Turkey Mountain forming a half window (cf. Baugh Mountain). The fold is related to interference between a north-northeast trending fold train (Horn, Calbeck, Johns anticlines) and a later east-northeast trending fold train (Horseleg, Lavender, Simms anticlines). The Turkey Mountain horse evidently relieved some of the stress on the Calbeck and Lavender anticlines and may conceal these folds in the subsurface beneath incompetent Floyd Shale.

6 Lavender Mountain-

Lavender Mountain Anticline occurs over a ramp in the Lavender Mountain Fault, which rises from the regional decollement (Conasauga shale) to the southwest, ramps through Ordovician-Devonian strata and evidently thrusts the Lavender Member of the Fort Payne Chert over Berry Limestone and Floyd Shale in Little Texas Valley. The anticline was oversteepened by out-of-sequence thrusting related to the Rome Fault, and the Lavender Mountain Fault was, consequently, folded by interaction with the Simms Mountain Anticline.

7 Horseleg Mountain-

The Horseleg Mountain Anticline is the earliest fold in the Horseleg, Lavender, Simms Mountain fold train developed due to the reactivation of the Rome and Coosa Faults to the south. New mapping shows that Mississippian limestone (Berry Limestone) extends much further north along the axis of the fold than once thought, in an area previously mapped as Conasauga limestone and shale. Incompetent Conasauga shale crops out on both limbs of the anticline in the hanging wall of the Rome Fault. Like the Lavender and Simms Mountain folds, Horseleg Mountain Anticline has been oversteepened by out-of-sequence movement on the Rome and Coosa Faults. Horseleg Fault cuts the folded Rome Fault, and probably developed as a consequence of oversteepening.

The Rome Fault is over-ridden by the Coosa Fault at the north end of Horseleg Mountain anticline but separation increases rapidly to the southwest. The two faults are around 19km (12 miles) apart at the state line 32km (20 miles) southwest with all intervening terrane occupied by Conasauga lithologies. This implies an unusually thick stratigraphic section of Conasauga in the footwall of the Coosa Fault and probably a ductile duplex (mushwad).

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