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THE GEOLOGY OF GRASSY COVE, CUMBERLAND COUNTY, TENNESSEE[1]

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INTRODUCTION

The rock formations which are exposed on the Cumberland Plateau

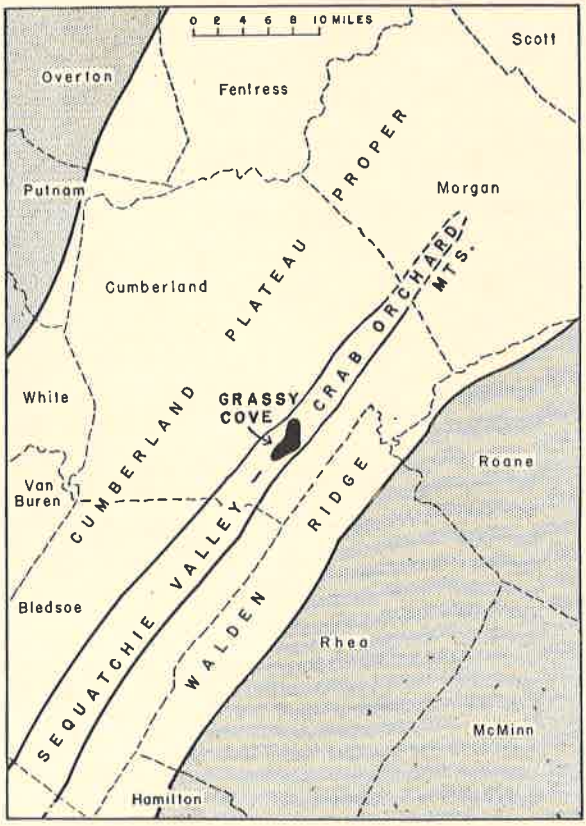

Fig. 1. Map of the east-central part of Tennessee showing counties and physiographic divisions of this region.

of Tennessee are predominantly Pennsylvanian in age. However, in a few places, rocks of Mississippian age have been bared by a

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combination of folding and erosion. These Mississippian formations outcrop in six coves in Cumberland County, Tennessee. The purpose of this paper is to give the distribution, description, and structure of the rock formations in Grassy Cove, the largest of the six coves in this area.

Grassy Cove is situated in southeastern Cumberland County, Tennessee, and is included in the Cumberland Plateau Province (Fig. 1).

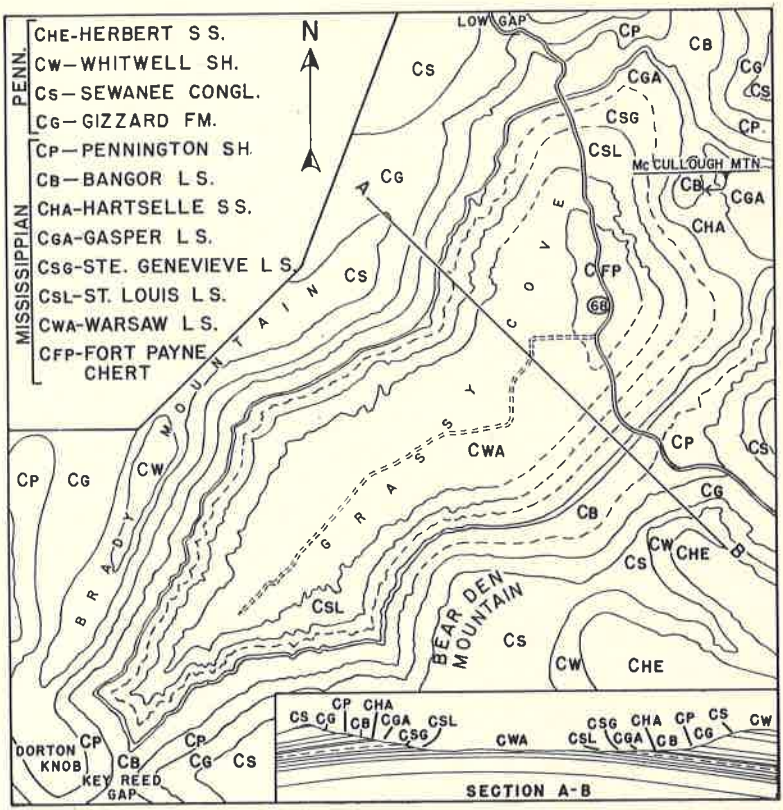

Fig. 2. Geologic map of Grassy Cove. The Grassy Cove, Tennessee, quadrangle map of the United States Geological Survey and the Tennessee Valley Authority was used in field mapping. Horizontal scale of the map and vertical scale of the cross section are the same. Scale 1:24000.

Its floor contains 3,884 acres, and the surface outline is roughly crescent shaped. From its center the cove tapers into narrow pointed valleys to the north and southwest. The north-south arm is 3.4 miles in length and the northeast-southwest arm 3.9 miles. The greatest width is 1.7 miles bisecting the cove equally along a northwest-southeast axis (Fig. 2).

Sedimentary rocks in Grassy Cove are Paleozoic in age, comprising Mississippian and Pennsylvanian formations. The latter strata consist

principally of sandstones and shales while the former are predominantly limestones with one shale and one thin sandstone member (Fig. 2). Alluvial deposits of late Tertiary or Recent age cover the major stream valley.

The Mississippian formations mapped in Grassy Cove are: the Fort Payne chert of Osage age, the Warsaw limestone, the St. Louis limestone, and the Ste. Genevieve limestone of Meramec age, and the Gasper oolite, Hartselle sandstone, Bangor limestone (restricted), and Pennington shale of Chester age. Pennsylvanian formations include the Gizzard Formation, Sewanee conglomerate, Whitwell shale, and Herbert sandstone of Lee age (Fig. 2).

STRATIGRAPHY

Mississippian Series

Fort Payne chert. The outcrops of the Fort Payne formation are restricted to the northeastern side of Grassy Cove. Alluvium deposited by Grassy Cove Creek on the floor of the cove covers most of the Fort Payne, but with the entire removal of this alluvium only the upper 40 feet of the Fort Payne would be exposed. Outcrops can be seen in the road cut along Tennessee Highway 68. Chert comprises more than fifty percent of the Fort Payne outcrop in Grassy Cove. Interbedded with it is a red and yellow clay that has decomposed from limestone. The chert is in horizontal bands from one-half inch to eight inches in thickness. It is white to light gray when fresh and dark gray when weathered. The chert weathers to a white friable clay which becomes very plastic and easy to mold when wet. Float of the Fort Payne chert has an exceedingly porous texture. Highly weathered chert shows that it is composed almost entirely of crinoid stems, a feature not easily recognized in the unweathered material.

Warsaw limestone. The Warsaw limestone underlies the greater part of the floor of Grassy Cove. In the central and southwestern sections of the cove the Warsaw is covered with alluvium and rock slides. However, complete exposures can be seen in the head of Grassy Cove Creek northwest of Dorton Knob and along the lower side of McCullough Mountain on the northeastern side of the cove. Its thickness is approximately 65 feet.

The lithology of the Warsaw varies from top to bottom. Layers of argillaceous sandstone alternate with coarsely crystalline, fossiliferous, arenaceous limestones, and green and blue sandy shales. The limestones are blue-gray to dark gray in fresh exposures. Crinoid stems, fragments of brachiopods, and bryozoans are numerous in the limestone layers. The surfaces of the arenaceous horizons weather superficially to red or brown sandstones. Cross-bedding is present in the sandy horizons.

Near the top of the Warsaw is a three foot bed of arenaceous limestone that weathers to a reddish sandstone. It is persistent along the sides of Grassy Cove and usually outcrops as a ledge. This weathered arenaceous limestone is used to separate the Warsaw from the overlying St. Louis limestone. In places where the Warsaw is

hidden from view its presence is easily recognized because of differential weathering. Red and brown sandstone rocks as much as one foot in diameter are present on the surface.

St. Louis limestone. In general the St. Louis limestone encircles Grassy Cove by closely paralleling the base of the surrounding mountains. It is 110 to 120 feet thick. Lithologically it is a fine-grained, bluish-gray limestone with beds varying from one to six or eight feet in thickness. The base comprises 10 feet of thin-bedded, green shale underlying a thin bed of light gray limestone. This shale is overlain by a series of chert layers interbedded with limestone. The chert layers range from a few inches to more than one foot in thickness. On the hillsides below outcrops, large chert fragments cover the surface. Overlying this chert is a light-colored, thick-bedded, semi-lithographic limestone, which appears white on the weathered surface, but light blue to light gray when fresh. Above the chert is a ten foot layer of light gray limestone with spherical chert nodules. The nodules are white to gray and because of their greater resistance to weathering stand out in rows of dark masses the size of walnuts or golf balls (Fig. 3). Spherical weathering is peculiar to the St. Louis in this region. Overlying this horizon is another cherty lime limestone layer, in which the chert differs in appearance from that below. It is typically blue in color and has a glassy texture. The weathered chert displays various shapes. Some nodules are pea-sized and oval while others are long and narrow with the shape of worm burrows.

The St. Louis limestone in this region contains the characteristic corals, *Lithostrotion canadense* and *L. proliferum,* common to this formation. Thirty feet above the base they are particularly abundant. Near the top of the St. Louis is a chert layer one to one and one-half feet in thickness containing large numbers of productids.

Ste. Genevieve limestone. The Ste. Genevieve encircles Grassy Cove. It is exposed along the northwestern side of the cove paralleling the base of Brady Mountain, in the head of Grassy Cove Creek, and along the western side of McCullough Mountain. Alluvium covers the Ste. Genevieve in the northern and southeastern sections of the cove. The Ste. Genevieve is a light gray to pearl-gray massive limestone, averaging from 90 to 100 feet in thickness. A few layers are highly oolitic, which differentiates this formation from the underlying St. Louis limestone. Weathered exposures of the Ste. Genevieve yield large chert fragments that contain many species of brachiopods.

The fossil, *Platycrinus huntsvillae (Penicillus)* was common throughout this formation. Nelson (1925, p. 33) stated that this fossil was common to abundant from top to bottom of this formation and absolutely diagnostic in this region.

Gasper oolite. The Gasper is exposed along the sides of Grassy Cove, except on the southeastern slopes of Brady Mountain where it is covered with rock slides, and in the northern and southeastern parts of the cove where alluvium has covered it. In this region the

Gasper oolite consists of two types of lithology and is 100 to 110 feet thick. The lower strata are thick-bedded, light gray, predominantly oolitic limestones. Some beds are as much as seven feet thick, although thickness of three or four feet are quite common. The upper layers are thiner-bedded, impure, argillaceous limestones, averaging one to two feet thick. They grade into the overlying Hartselle sandstone.

Fig. 3. St. Louis Limestone. Differential weathering causes chert nodules to stand out on exposed surfaces. About 3000 feet west of Milk Sick Cave in the southwestern arm of Grassy Cove.

A white, friable, argillaceous limestone, two to four feet thick is present near the contact of the Ste. Genevieve and Gasper limestones. Above it *Platycrinus huntsvillae,* index to the underlying argillaceous limestone are clusters of the coral *Campophyllum gasperense.* According to Butts (1926, p. 190) this fossil is confined to the lower part of the Gasper oolite.

Hartselle sandstone. Extensive exposures of this formation are present along the mountain side surrounding Grassy Cove and underlying the ridge across the southeastern part of the cove. The Hartselle caps most of McCullough Mountain and forms a dip slope on the southeast.

The Hartselle sandstone is a widely distributed lithologic unit in Grassy Cove and is used to separate the Gasper oolite and the Bangor limestone (restricted). It is a medium-grained, greenish white, massive, calcareous sandstone, varying in thickness from five to forty feet. On unweathered surfaces the Hartselle superficially resembles a dark, massive limestone, firmly cemented with calcium carbonate. Upon weathering it changes to a red, brown, or yellow sandstone, displaying prominent cross-bedding. Archimedes are present in the Hartselle on the eastern side of McCullough Mountain.

Bangor limestone (restricted). The Bangor is widely exposed along the sides of the mountains about Grassy Cove. It underlies Key Reed Gap at the southwestern end of Grassy Cove, and on the northeastern side of Grassy Cove it is exposed in a wind gap between Grassy and Little Coves. Approximately 40 feet of lower Bangor caps McCullough Mountain. The Bangor is a medium to thick-bedded, blue, coarsely crystalline, highly fossiliferous, and at places fragmental and oolitic limestone. It is 150 to 160 feet thick. The lower 100 feet is highly fossiliferous while the upper 50 to 60 feet is either an argillaceous or oolitic limestone. The upper layers show a gradual change from the purer limestones of the lower Bangor to the muds and shales of the overlying Pennington.

The forty feet of Bangor overlying the Hartselle sandstone is coarse dark gray to brownish-gray limestone that weathers into thin fragments. At places it is slightly arenaceous, and contains horn corals, brachiopods, and crinoid stems. The middle of the Bangor is a bluish-gray, medium-grained limestone with a profusion of bryozoa, crinoids, and archimedes. Archimedes are diagnostic of the Bangor. Geodes are numerous. These are spherical bodies of calcite from one to four inches in diameter. They have a milky white color which differs from the clear colorless crystals found at some localities. The upper part of the Bangor alternates between oolitic and light gray, slabby, argillaceous limestones. These layers are non-fossiliferous.

Pennington shale. This formation is the youngest Mississippian formation in Grassy Cove. It is exposed along the upper slopes of the mountains surrounding Grassy Cove and extends southwest through Key Reed Gap. Here this formation loops around Dorton Knob and is exposed along the western side of Brady Mountain. The major unconformity that generally occurs at the top of the Mississippian system could not definitely be located in this area, because the debris from the sandstone bluffs above and the thick vegetation on the slopes prevent good exposures. This formation is 150 to 160 feet thick. It is extremely easy to recognize because of its characteristic bright red and olive-green colors interbedded with yellow layers of shale. The shale is extremely fissile and usually has the appearance

of fish scales. Outcrops of the Pennington are rare except in road cuts, because of the talus cover from the overlying sandstones.

At the base of the Pennington is a coarse limestone which resembles a sandstone when weathered. Overlying this is a dark gray to greenish fissile shale which weathers superficially to a yellow or cream color. In places it is laminated and breaks into long slender or linear fragments. This grades into a dark blood-red shale that weathers into a fine powder. Above this are six feet of very compact, massive, argillaceous, fossiliferous limestone that is cream colored at the surface, but when fresh is light gray. Above this layer and separated from it by red and green shale is another light gray argillaceous limestone. This is followed by another 25 feet of dark gray to blue, coarse-grained limestone composed almost entirely of crinoid stems and pentremites. Sixty feet above this is another very fossiliferous dark-blue limestone four feet thick with fossils similar to those in the lower limestone member. Fifty feet below the top of the Pennington is 17 feet of slabby, greenish-yellow, slightly calcareous sandstone. These layers are approximately one inch in thickness. In its upper one-third, this formation is composed of red, green, and yellow shales like those typical of the lower Pennington.

Pennsylvanian System

Gizzard formation. This formation is exposed just below the crests of the mountains surrounding Grassy Cove. It caps Brady Mountain to the northwest of Grassy Cove where the overlying Sewanee has been removed by rock slides. From Dorton Knob the Gizzard is exposed along the western side of Brady Mountain where it follows closely the surface slope. The Gizzard varies in thickness from 200 feet along Brady Mountain to 311 feet along the side of Brown Mountain on the eastern side of Grassy Cove. The average thickness is 240 to 260 feet. This formation consists chiefly of fine to medium-grained, hard, comparatively thin-bedded, and non-conglomeratic sandstones alternating with arenaceous shales and a few plastic clay layers.

Lithologically, the Gizzard may be divided into three parts: (1) a lower shale including thin sandstones and at least one coal seam, (2) a sandstone lentil which is brown to yellow, fine to medium-grained, and massive; this probably represents the Warren Point sandstone, (3) an upper shale with layers of thin-bedded sandstones.

There are at least two coal seams and possibly a third represented in this formation. Two outcrops can be seen in Stillhouse Hollow, which extends through the mountains at the east-central side of Grassy Cove. One horizon is 50 feet above and the other is 30 to 40 feet below the Warren Point sandstone. The lower coal is now being mined.

Sewanee conglomerate. The Sewanee overlies the Gizzard formation and underlies the Whitwell shale. It is well exposed on all the higher mountains of this area, either capping them or outcropping near their crests. This formation has a wide exposure on Bear Den

and Brady Mountains where the slopes follow closely the dip of the rocks. The Sewanee has a maximum thickness of 140 feet around Grassy Cove but becomes thinner to the west. This formation is competent and stands conspicuously in high bluffs above the cove.

The Sewanee is easily recognized by its many milky-white quartz pebbles which are one-sixteenth of an inch to one and one-half inches in diameter with rounded to elongated shapes. These pebbles are concentrated in bands or layers from a few inches up to a foot in thickness. This formation is characteristically a thick-bedded, hard, massive, cross-bedded, coarse-grained, brown to yellow sandstone. The quartz grains which compose the matrix are round to subangular. The Sewanee, where exposed in bluffs, weathers to a soft sandstone and crumbles easily. Bands of limonite cement from a few inches up to two feet thick are present near the base of the sandstone, producing a very hard ferruginous conglomerate. Scattered mounds of this material about the floor of Grassy Cove were probably placed by large rock slides in the past.

Whitwell shale. The exposure of this formation is limited in the area of this report to the crest and southeastern slope of the mountains on the east-central side of Grassy Cove and it caps the highest summit on Brady Mountain. The Whitwell shale is 60 to 140 feet in thickness. Much of it is concealed by talus and soil because of its softness in comparison with the Herbert and Sewanee formations which adjoin it. The lower half is yellow to brown sandy shales and thin-bedded sandstone. The shales weather into long slender fragments. The upper Sewanee coal lies 20 to 30 feet below the Herbert sandstone, and varies greatly in thickness from place to place. Some pockets contain 20 feet of a good grade of bituminous coal while only a few yards away there may be only a few inches of poor argillaceous coal. Fossil plants are found in the coal and shale partings. The coal is overlain by a blue clay, two to four feet thick, which grades upward into arenaceous shale one or more feet in thickness. Here clay nodules are surrounded with a film of sandstone. Near the top of the Whitwell, sandstone layers from two to three inches up to one foot in thickness are interbedded with shales. These are impregnated with streaks of red and purple iron oxide.

Herbert sandstone. This formation is not present within Grassy Cove but on the mountains along the east-central side of Grassy Cove it follows the dip slope to the southeast. The Herbert is 50 to 60 feet thick, and stands as a bluff above the weaker Whitwell shale. On Walden Ridge southeast of Grassy Cove it has a highly irregular outcrop pattern. This formation is evenly bedded, fine to medium-grained, massive, and ranges in color from white to yellow to red. Nelson (1925, p. 49) reported that the Herbert is conglomeratic in places, but no quartz pebbles were observed in the area of this report.

STRUCTURE

Structurally, Grassy Cove is a part of the Sequatchie anticline. This anticline extends for nearly 200 miles along the median line of

the Cumberland Plateau in Tennessee and Alabama. It extends across Grassy Cove with a strike of N. 42° to 45° E. The southwestern arm of Grassy Cove follows the crest of this anticline. Also astride the center of this fold are Dorton Knob and McCullough Mountain. Here the Sequatchie anticline is nearly symmetrical, with limbs dipping away form the crest at angles of one to twelve degrees. The greatest dips are from one-half to one and one-half miles distance from the crest of the anticline (Fig. 2).

The Sequatchie anticline in Grassy Cove plunges gently to the northeast. From Dorton Knob to Black Mountain this plunge is 0.3 degree or approximately 30 feet per mile to the northeast.

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