COLUMNAR SECTION

SYSTEM	SERIES	STRATIGRAPHIC UNIT	THICKNESS IN FEET	LITHOLOGY	NOTES
QUATERNARY	Holocene	Surficial units (not to scale)			EXPOSED ROCKS
	Pleistocene				
CRETACEOUS	Upper	Straight Cliffs Formation: UNCONFORMITY			
		John Henry Member	945+		Christensen coal zone
		UNCONFORMITY: Smoky Hollow Member	54		
		Tibbet Canyon Member	116		
		Tropic Shale	650		
	Lower(?)	Dakota Formation	53		
JURASSIC		UNCONFORMITY			
	Upper	Morrison Formation: Upper member	234		
		Salt Wash Member	548		
		UNCONFORMITY: Sandstone at Romana Mesa	28		
		UNCONFORMITY: Entrada Sandstone: Middle member	187		
		Lower member	735		
		Upper member of Carmel Formation	148		
	Middle	Sandstone at Page	56		
		UNCONFORMITY			
TRIASSIC(?) AND JURASSIC		Navajo Sandstone	1230		BURIED ROCKS
TRIAS-SIC(?)		Kayenta Formation	329		Drilled 4 miles west of map area by Romex Corp. in 1970. No. 1 Federal-Rock Creek well in the NW¼NW¼ sec. 19, T. 41 S., R. 7 E. Spudded in upper member of Carmel Formation, total depth 3,969 feet, bottomed in Cedar Mesa Sandstone Member of Cutler Formation.
		Wingate Sandstone	249		
TRIASSIC	Upper	UNCONFORMITY: Chinle Formation: Owl Rock Member	127		
		Petrified Forest Member	841		
		Shinarump Member	196		
		UNCONFORMITY			
	Middle(?) and Lower	Moenkopi Formation	268		
		UNCONFORMITY			
PERMIAN	Lower	Kaibab Limestone	128		
		White Rim Sandstone Member	209		
		Organ Rock Member	415		
		Cutler Formation	1539		
		Cedar Mesa Sandstone Member	915		Drilled 16 miles northwest of map area by Byrd Corp. in 1954. No. 1 Govt. well in the SE¼SE¼ sec. 5, T. 40 S., R. 5 E. Spudded in Straight Cliffs Formation, total depth 10,045 feet, bottomed in Bright Angle Shale.
		Halgaito Tongue	532		
		UNCONFORMITY			
PENNSYLVANIAN	Upper and Middle	Hermosa Formation	498		Mississippian and older rocks modified from Munger and others, 1965).
	Lower	Molas Formation	154		
MISSISSIPPIAN	Upper	Redwall Limestone: Horseshoe Mesa Member	160		
	Lower	Mooney Falls Member	289		
		Thunder Springs and Whitmore Wash Members	232		
DEVONIAN	Upper	Ouray(?) Limestone	144		
		Elbert Formation	147		
		UNCONFORMITY			
CAMBRIAN	Middle	Muav Limestone	434		Drilled 50 miles west of map area by Tidewater Oil Co. in 1957. No. 1 Kaibab Gulch well in the SW¼NE¼ sec. 34, T. 42 S., R. 2 W. Spudded in Kaibab Limestone, total depth 6,253 feet, bottomed in Precambrian rocks.
		Bright Angel Shale	676		
	Lower	Tapeats Sandstone	290		
		UNCONFORMITY			
PRECAM-BRIAN					Lithology unknown in map area.

DESCRIPTION OF MEASURED SECTIONS

1. Surficial units:
Landslide and talus deposits (Qls): landslide materials, toreva blocks, and unsorted boulders, gravel, sand, and mud in talus sheets at foot of cliffs; 0–30 feet.

Straight Cliffs Formation:

2. John Henry Member: interbedded sandstone and mudstone; sandstone, very light gray to grayish-orange, very fine grained to fine-grained, ripple cross-laminated to thickly crossbedded; mudstone, gray to black, laminated to very thin bedded. Contains scarce coal beds and carbonaceous mudstone in the Christensen coal zone and a thin basal conglomerate composed of chert and quartzite pebbles; forms cliffs. Top eroded. Lower contact sharp, regional studies indicate it is an unconformity. Marginal marine to lagoonal and paludal deposits.
3. Smoky Hollow Member (30–66 ft):
Barren zone (25 ft): interbedded sandstone and mudstone. Sandstone, grayish-orange to yellowish-gray, very fine grained to medium-grained, very thinly to thickly crossbedded; contains scarce small chert pebbles. Mudstone, dusky-yellow to light-olive-gray, very thin bedded. Forms steep slopes; lower contact gradational and interfingering. Alluvial-plain deposits.
Coal zone (19 ft): mudstone, carbonaceous, gray to black, laminated to very thin-bedded; carbonized plant fragments abundant; contains thin coal beds; forms steep slopes; lower contact sharp and conformable, interfingering in nearby areas; lagoon and coastal swamp deposits.
4. Tibbet Canyon Member (62–150 ft): sandstone, yellowish-gray to grayish-orange; middle and upper parts are fine-to medium grained, thin to thick bedded, and thinly to thickly crossbedded; grades downward to lower part which is very fine grained and laminated to very thin bedded and thinly crossbedded and contains several siltstone and mudstone beds; fossils scarce; lower contact gradational and interfingering; marginal marine and beach deposits.
5. Tropic Shale (640–730 ft): shale, bentonitic, medium-dark-gray, laminated to very thin bedded; calcareous about 25–450 feet above base. Upper 50–100 feet, dusky-yellow to light-olive-gray mainly very thin bedded mudstone and siltstone; forms slope. Thin white bentonite beds common in lower 50 feet, uncommon above. Contains the following types of limestone concretions (in ft above base): about 550 feet, cone-in-cone structure, rare; 12–30 feet, fossiliferous, common; lower 10 feet, septarian, rare. Lower contact fairly sharp; formation generally concealed by talus; offshore marine deposits.
6. Dakota Formation (18–70 ft):
Upper member (24 ft): mainly cliff-forming sandstone, grayish-orange to moderate-brown, very fine grained to fine-grained, thin-bedded to massive, fossiliferous at top; in lower part contains thin beds of slope-forming gray fossiliferous mudstone and shale containing several very thin coquinoid marlstone lenses. Lower contact sharp and conformable. Brackish-water to marine deposits.
Middle member (25 ft): mudstone, dark-gray and carbonaceous or yellowish-green; includes several thin coal beds; forms slopes; lower contact sharp and conformable; locally interfingering; swamp or marsh deposits.
Lower member (4 ft): sandstone, dark-gray, irregularly flat bedded; contains carbonaceous flakes and scattered pebbles; forms minor ledge; lower contact sharp and unconformable; fluvial and residual deposits.
Morrison Formation (470–680 ft):
7. Upper member (150–355 ft): interbedded sandstone and mudstone. Sandstone, light-gray, very light gray, and light-brownish-gray, very fine grained to medium-grained, thinly to thickly crossbedded and less commonly very thin-bedded to thin-bedded; contains scattered pebbles. Mudstone, grayish-yellow-green to dark-reddish-brown, irregularly very thin bedded to thin bedded. Locally at top is a unit as much as 50 feet thick of conglomerate and pebbly sandstone that contains petrified logs and that may correlate with Cedar Mountain Formation (Lower Cretaceous) of central Utah. Lower contact fairly sharp although interfingering. Alluvial-plain deposits. Member distinguished from Salt Wash Member because it contains more mudstone and generally whiter sandstones and forms ledgy slopes.
8. Salt Wash Member (310–330 ft): sandstone, very light gray, yellowish-gray, brownish-gray, and grayish-yellow-green (generally weathers dark brown), very fine grained to medium-grained, thinly to thickly crossbedded; scattered pebbles and conglomerate lenses common; contains several beds of grayish-yellow-green and dark-reddish-brown irregularly very thin bedded to thin-bedded mudstone; forms cliffs; lower contact sharp and channeled, regional studies indicate it is an unconformity; alluvial-plain deposits.
9. Sandstone at Romana Mesa (0–55 ft): sandstone, yellowish-gray, fine-grained, very thin bedded to thin-bedded and thickly crossbedded; scattered coarse grains common; forms cliffs; lower contact sharp, regional studies indicate it is an unconformity; probably nearshore marine deposits. Width of outcrop band on map may be slightly exaggerated in cliffs to show continuity. Regional studies indicate that the sandstone at Romana Mesa correlates with the Summerville Formation farther north in central Utah.

Entrada Sandstone (730–830 ft):

10. Middle member (180–380 ft): sandstone, very light gray, moderate-reddish-orange, and moderate-reddish-brown, very fine grained, very thin bedded to thick-bedded and thinly to thickly crossbedded; includes minor dark-reddish-brown mudstone and scarce very thin beds of grayish-purple bentonite; generally forms red and white banded cliff; lower contact conformable and locally gradational, stratigraphic position in relation to upper contact may vary by as much as 50 feet owing to broad intraformational folds and probably to interfingering. Probably shallow marine, tidal-flat, lagoonal, and eolian deposits. Width of outcrop band on map may be slightly exaggerated in cliffs to show continuity.
11. Lower member (390–610 ft): sandstone, moderate-reddish-orange, very fine grained, thinly to thickly crossbedded; contains several beds of laminated thin-bedded sandstone and silty sandstone; forms smooth cliff with rounded shoulder at top; lower contact sharp and conformable; probably eolian and nearshore marine deposits. Large irregular slumps that extend down into the upper member of the Carmel Formation are common at the base and locally are mapped with the upper member of the Carmel.

The two members of the Entrada correlate with the lower two of three members that can be recognized about 40 miles northwest of the map area near Escalante, Utah. The upper part of the middle member locally contains several sets of large-scale cross-stratification and may correlate with the large-scale cross-stratified upper member of the Entrada near Escalante. These members do not correlate with the lower sandy, medial silty, and upper sandy members of the Entrada of northeastern Arizona (Harshbarger and others, 1957).

12. Upper member of Carmel Formation (140–200 ft): interbedded sandstone, silty sandstone, and mudstone. Sandstone, generally moderate reddish orange to moderate reddish brown although several beds are very light gray, very fine grained, very thin bedded to thin-bedded and locally thinly to thickly crossbedded. Silty sandstone and mudstone, moderate-reddish-orange to pale-reddish-brown; laminated to very thin bedded and ripple cross-laminated; includes scarce very thin beds of grayish-purple bentonite. Lower contact sharp but locally gradational, conformable; forms ledgy slopes; a lower member known as the Judd Hollow Tongue is present about 30 miles west of map area; shallow marine and tidal-flat deposits, possibly lagoonal in part.
13. Sandstone at Page (15–70 ft): sandstone, moderate-reddish-orange to moderate-reddish-brown, fine-grained, very thickly crossbedded; small angular chert pebbles at base; forms cliffs; lower contact sharp, regional studies indicate it is an unconformity; eolian deposits.
14. Navajo Sandstone: sandstone, moderate-reddish-orange to grayish-pink and very light gray, fine-grained, very thickly crossbedded; forms cliffs; only upper 700 feet exposed in map area; eolian deposits.
15. Kayenta Formation: sandstone, reddish-brown to pink, fine-grained; interbedded with small amounts of orange to pink siltstone and red shale; fluvial deposits.
16. Wingate Sandstone: sandstone, orange, fine-grained; contains scarce orange siltstone and red shale; eolian deposits.

Chinle Formation:

17. Owl Rock Member: interbedded shale, siltstone, and mudstone, red, orange, and pink, and pink clayey dolomite; lacustrine deposits.
18. Petrified Forest Member: interbedded shale, siltstone, and mudstone, variicolored, bentonitic; contains scarce thin beds of pink fine-grained sandstone and greenish-gray to pink limestone; fluvial and lacustrine deposits.
19. Shinarump Member: conglomerate and pebbly sandstone, light-gray to light-brown; includes small quantities of grayish-green shale and siltstone; upper approximately 100 feet may correlate with Monitor Butte Member farther east; fluvial deposits.
20. Moenkopi Formation: shale and siltstone, maroon, orange, and pink, micaceous; probably deposited in lagoons and on tidal flats.
21. Kaibab Limestone: dolomite, light-brown, cherty; contains algal structures; marine deposits.

Cutler Formation:

22. White Rim Sandstone Member: sandstone, white to light-brown, fine- to medium-grained; interbedded with smaller amounts of light-brown silty and cherty dolomite; includes scarce beds of red shale; marginal marine deposits.
23. Organ Rock Member: interbedded shale, claystone, and siltstone, maroon, orange, red, and pink; includes scarce beds of white, orange, and light-brown very fine grained to fine-grained sandstone and traces of anhydrite; probably alluvial-plain deposits.
24. Cedar Mesa Sandstone Member: sandstone, white to light-brown, fine-grained; includes red, orange, pink, maroon, green, and light-brown siltstone, red to green shale, and scarce light-brown to pink silty and cherty limestone; marginal marine and eolian deposits.
25. Halgaito Tongue: interbedded white to light-brown fine-grained sandstone, pink, red, orange, and light-brown siltstone, red shale, pink and light-brown limestone, and pink to red dolomite; the limestone and dolomite contain algal structures. Basal 6 feet is limestone and chert pebble conglomerate; probably alluvial-plain and marginal marine deposits.
26. Hermosa Formation: interbedded white, pink, and light-brown fine- to medium-grained sandstone, red, pink, and light-brown siltstone, red shale, white to light-brown limestone that contains algal structures, and white to red chert; marine deposits.
27. Molas Formation: shale, maroon, and light-brown limestone in middle that contains algal structures and chert; marine and nonmarine deposits.

Redwall Limestone:

28. Horseshoe Mesa Member: limestone, light-brown to white; contains chert, algal structures, and fractures filled with red clay; marine deposits.
29. Mooney Falls Member: dolomite, white to light-brown, crinoidal and cherty; contains scarce thin beds of light-brown limestone; marine deposits.
30. Thunder Springs and Whitmore Wash Members: dolomite, white, fossiliferous; contains white tripolitic chert; marine deposits.
31. Ouray(?) Limestone: dolomite and limestone, light-brown, gray, white, and scarce red to pink; contains algal structures; includes thin beds of purple shale; marine deposits.
32. Elbert Formation: dolomite and limestone, light-brown; contains algal structures; includes several thin purple to green shale beds, especially in upper 25 feet; basal 20 feet is white to light-brown silty and dolomitic sandstone that probably correlates with the McCracken Sandstone Member of Knight and Cooper (1955) farther east; marine deposits.
33. Muav Limestone: dolomite and limestone, brown to gray, silty; contains oolites, chert, glauconite, and algal structures; includes thin red to green shale and siltstone beds; marine deposits.
34. Bright Angel Shale: shale, silty, red, green, and gray, glauconitic, calcareous and dolomitic; contains siltstone and silty to pebbly sandstone. Includes gray oolitic and pelletal dolomitic limestone and minor dolomite beds which are tongues of the Muav Limestone; marine deposits. Thickness shown is corrected from regional trends for application to map area.
35. Tapeats Sandstone: sandstone, pebbly, gray to reddish-brown, medium- to coarse-grained, feldspathic and glauconitic; contains thin red to green shale beds; marginal marine deposits.

EXPLANATION

Intermediate or interbedded lithologies shown by combination of symbols

- Conglomerate
- Sandstone
- Fluvial channel sandstone
- Mudstone, gray to yellowish-green
- Carbonaceous mudstone
- Shale
- 1.9 Coal bed; thickness, in feet
- 1.9 Coal bed with thin parting; thickness in feet
- Bentonite
- Fossiliferous limestone concretions
- Partly covered
- Covered
- 131 Interval omitted; thickness, in feet

FOSSIL LOCALITY

307 Field locality number

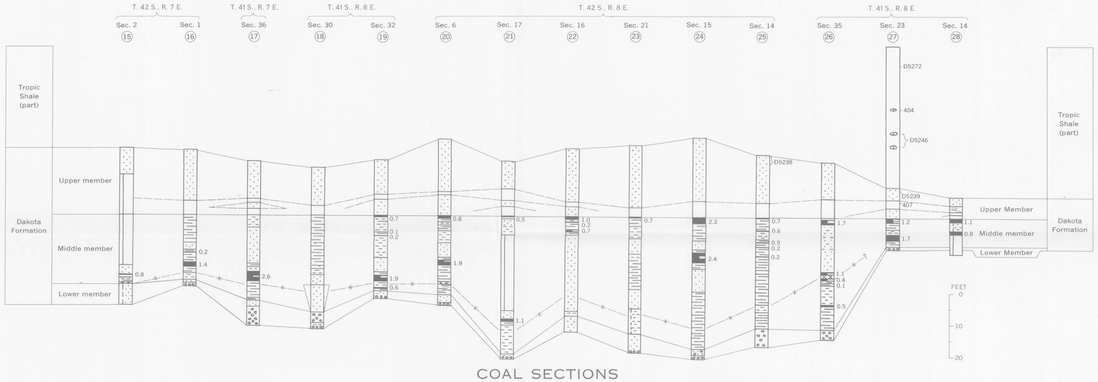
D5272 U.S. Geological Survey Mesozoic fossil locality (Denver catalogue). Locality D6593 is a talus block that probably came from the lower 170 feet of the John Henry Member

(5) Number of coal section

CORRELATION SYMBOLS

Formation or member boundary

Other correlation within formation



COAL SECTIONS

GEOLOGIC MAP AND COAL RESOURCES OF THE NORTHEAST QUARTER OF THE CUMMINGS MESA QUADRANGLE, KANE COUNTY, UTAH

By
Fred Peterson and B. E. Barnum

1973

FOSSIL COLLECTIONS

[Stratigraphic position shown on coal sections. Faunal zones are those of Cobban and Reeside (1952), Cobban (1961), and Scott and Cobban (1964). Collected by Fred Peterson, 1965-68]

USGS Mesozoic locality	Field number	Identified by	Formation and member	Fossils	Faunal zone
-----	310	Fred Peterson	Straight Cliffs Formation, John Henry Member	*Serpula* sp.	
				Inoceramus sp.	
				Ostrea sp.	
				Cardium cf. C. pauperculum Meek.	
				Ophiomorpha sp.	
D5287	---	W. A. Cobban and Fred Peterson	---do-------	*Ostrea* sp.	
				Baculites sp.	
D5307	---	Fred Peterson	---do-------	*Ophiomorpha* sp.	
				Inoceramus sp.	
				Gyrodes cf. G. conradi Meek.	
				G. cf. G. depressus Meek.	
				Rostellites? sp.	
D6593	---	W. A. Cobban and N. F. Sohl	---do-------	*Inoceramus (Volviceramus) involutus* Sowerby.	
				Gyrodes sp.	
				Bellifusus? sp.	
				Helicaulax? sp.	
D5285	---	W. A Cobban and Fred Peterson	---do-------	*Inoceramus* sp.	Zone of *Scaphites depressus* Reeside.
				Gyrodes cf. G. depressus Meek.	
				Placenticeras sp.	
				Protexanites shoshonensis (Meek),	
				Ptychodes sp.	
-----	307	Fred Peterson	---do-------	*Inoceramus* cf. *I. stantoni* Sokolow.	
				Ostrea sp.	
				Ophiomorpha sp.	
-----	302	---do-------	Straight Cliffs Formation, Tibbet Canyon Member.	*Cardium cf. C. pauperculum* Meek.	Zone of *Prionocyclus hyatti* (Stanton).
-----	305	---do-------	Tropic Shale.	*Cardium cf. C. pauperculum* Meek.	Do.
D5272	---	---do-------	---do-------	*Inoceramus* cf. *I. labiatus* (Schlotheim).	Probably Zone of *Inoceramus labiatus* (Schlotheim),
				Pholopteria sp.	
				Drepanochilus ruida (White),	
				Watinoceras? sp.	
				Fish scale, undet.	
-----	404	---do-------	---do-------	*Serpula intrica* White.	Zone of *Sciponoceras gracile* (Shumard).
				"Gryphaea" newberryi Stanton.	
				Camptonectes platessa White.	
				Ptilomya meeki (White).	
				Corbula kanabensis Stanton.	
				Exogyra sp.	
				Turritella whitei Stanton.	
				Drepanochilus ruida (White),	
				Arrhoges prolabiata (White),	
				Sciponoceras gracile (Shumard),	
				Allocrioceras annulatum (Shumard).	
				Metoicoceras whitei Hyatt,	
D5246	---	---do-------	---do-------	*Solemya*? *obscura* Stanton,	Do.
				"Gryphaea" newberryi Stanton,	
				Exogyra sp.	
				Lucina subundata Hall and Meek.	
				Corbula kanabensis Stanton.	
				Siguretus (Eunaticina?) textilis Stanton.	
				Exogyra sp.	
				Turritella whitei Stanton.	
				Sciponoceras gracile (Shumard),	
				Allocrioceras annulatum (Shumard),	
				Metoicoceras whitei Hyatt,	
D5239	---	W. A. Cobban and Fred Peterson	Dakota Formation, upper member.	*Pinna petrina* White,	Zone of *Dunveganoceras conditum* Haas.
				Pholopteria sp.	
				Ostrea sp.	
				Exogyra levis Stephenson.	
				E. olisiponensis Sharpe,	
				Plicatula sp.	
				Cardium sp.	
				Callistina? sp.	
				Corbula sp.	
				Gyrodes? sp.	
D5238	---	Fred Peterson	---do-------	*Metoicoceras defordi* Young.	
-----	407	---do-------	---do-------	*Exogyra levis* Stephenson.	Do.
				Ostrea sp.	Probably Zone of *Dunveganoceras pondi* Haas.
				Corbula sp.	

ECONOMIC GEOLOGY

INTRODUCTION

Most of the map area is included in the Glen Canyon National Recreation Area which is administered by the National Park Service. The Recreation Area was established primarily to include Lake Powell, the reservoir currently forming behind Glen Canyon Dam, which is about 23 miles southwest of the map area near Page, Ariz. The area is dissected into colorful buttes, canyons, and mesas that are carved in rocks of Triassic, Jurassic, and Cretaceous age.

Lake Powell, currently filling Glen Canyon and inundating the canyons in the southern part of the map area, rose from approximately 3,450 feet to 3,690 feet above sea level while the area was being mapped; ultimately it will reach a maximum altitude of about 3,710 feet. The geology of the submerged lands was interpreted from aerial photographs flown in 1951, aided by a brief reconnaissance in 1963. The quadrangle was mapped primarily as part of the U.S. Geological Survey program of evaluating and classifying mineral lands in the public domain.

COAL

Several thin beds of subbituminous or bituminous coal occur in the Straight Cliffs and Dakota Formations. The coal is of marginal value because the seams are thin and in rugged and isolated terrain and because thicker and more accessible seams occur 12 or more miles west of the map area in the main part of the Kaiparowits coal field.

Coal in the Straight Cliffs Formation occurs in the Christensen coal zone of the John Henry Member and in the Smoky Hollow Member. Several thin coal seams in the Christensen coal zone are present at Spencer Point and Navajo Point, but they thin and pinch out northeastward and are not present in the northern part of the map area. The Smoky Hollow Member contains one or two thin coal beds that could not be traced out because the member is largely concealed by talus. Coal in the Straight Cliffs Formation probably has a heating value of 10,000–12,000 British thermal units (on an as-received basis) based on analyses of coal taken from abandoned mines about 23–25 miles west of the map area (Waldrop and Sutton, 1966).

The middle member of the Dakota Formation also contains several coal beds that are thin and lenticular. This coal probably has a heating value of 10,000–11,000 Btu (as-received) based on an analysis of coal taken from an abandoned mine about 22 miles west of the map area (Waldrop and Peterson, 1966).

A summary of data pertaining to the coal deposits of the entire Kaiparowits coal field is presented by Doelling (1970).

OIL AND GAS

Rock Creek anticline in the middle of the map area is a fairly large structure that offers potential for oil and gas development. One dry hole was drilled on this fold about 4 miles west of the map area by the Romex Corp. (No. 1 Federal-Rock Creek) as a test of Permian strata. The well was drilled to a total depth of 3,969 feet and bottomed in the Cedar Mesa Sandstone Member of the Cutler Formation. Pennsylvanian, Mississippian, and Devonian strata offer the greatest potential for oil and gas below the Cutler Formation.

GROUND WATER

Several small springs or seeps issue from the clean sandstones in the Straight Cliffs Formation, and possibly some of these could be developed to produce small quantities of water. The Navajo Sandstone is an excellent aquifer because it is porous and permeable and because it is recharged from Lake Powell.

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