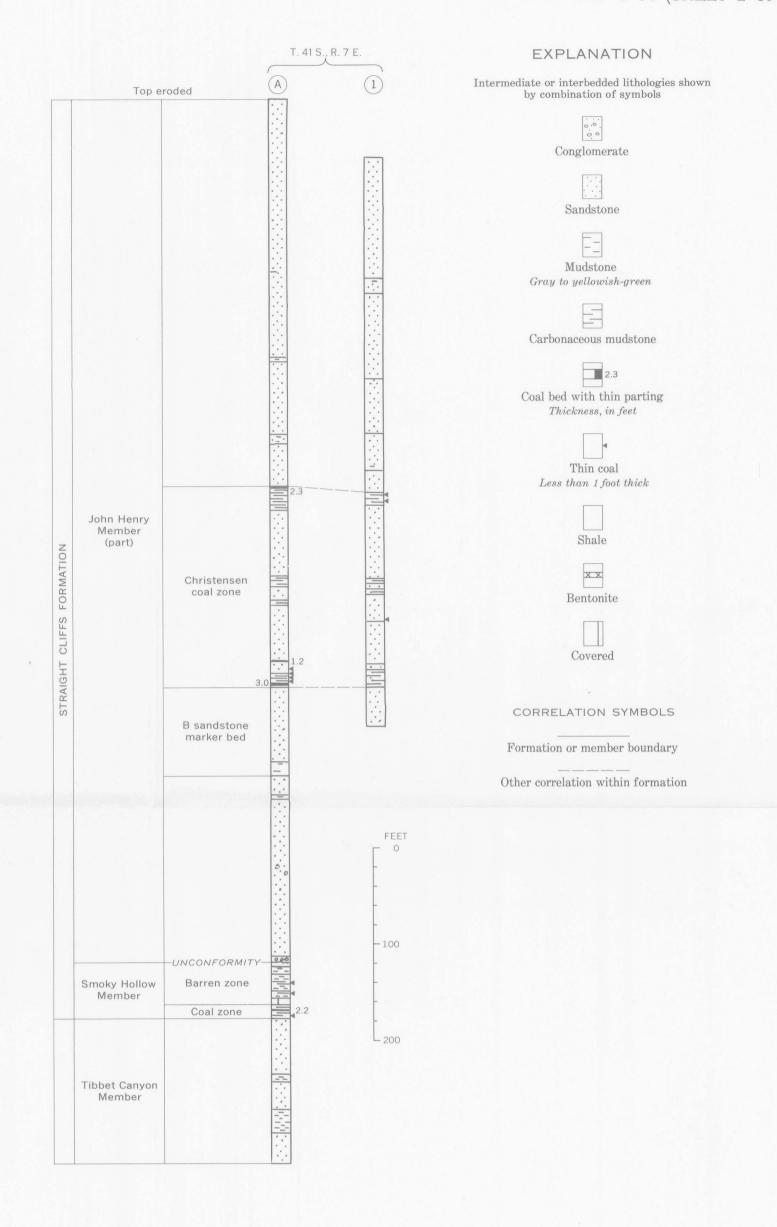
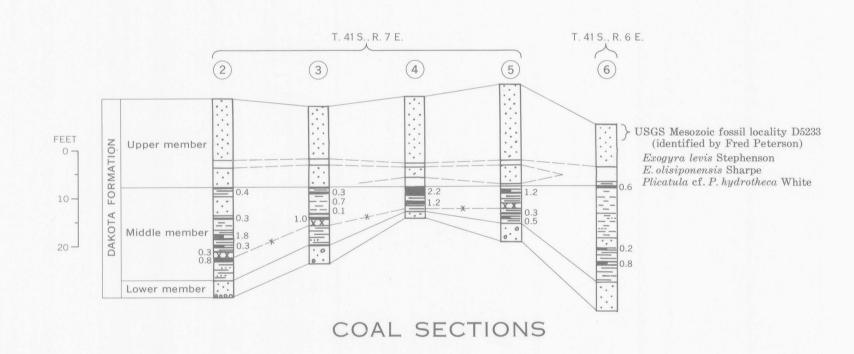
COLUMNAR SECTION

						C(JLL	JMNAR SECTIO	NIC		
SYSTEM	SERIES	ST	RATIGRAPHIC UNIT	THICK IN F	(NESS,	LITHOLOGY		NOTES			DESCRIPTION
	Holocene				CEI	Qe. Qal			1.	. Surficial units:	
QUATERNARY			Surficial un (not to scal			QIt 200p	1	EXPOSED ROCKS			porly sorted gravel, sand, and mud on present flood plains; locally and eolian deposits; 0–20 feet.
	Pleistocene		—UNCONFORMITY—			Qt	_			Landslide and tal	Qe): windblown sand and silt; 0–20 feet. lus deposits (Qlt): landslide materials, toreva blocks, and unsortec
CRETACEOUS	Upper	tion			900+					Terrace deposits	l, sand, and mud in talus sheets at foot of cliffs; 0–30 feet. (Qt): poorly sorted gravel and sand; subscript numbers on map in
							.)			more complete	height above present flood plains and probable correlation with a sequence of terrace deposits at Warm Creek about 12 miles
		Formation	John Henry				2			erosion cycle of	ap area (Peterson, 1973). Qt ₂ –Qt ₆ probably formed during Wupatk f middle and late Pleistocene age (Cooley and others, 1969, p. A35) ts (Qp): poorly sorted gravel, sand, and mud on pediment surfaces
		Straight Cliffs Fo	Member	1107+			3 >	Christensen coal zone	2.	0-20 feet. Sub	oscript numbers on map indicate probable correlation with terrace elative height above present flood plains; Qp_2 is lowest.
							5			Straight Cliffs Form	The state of the s
						0.000	.)			gray to grayish	l-orange, very fine grained to fine-grained, ripple cross-laminated bedded; mudstone, gray to black, laminated to very thin bedded
			Smoky Hollow Mbr			ميدورو	3			Contains scarce	e coal beds and carbonaceous mudstone in the Christensen coa n basal conglomerate composed of chert and quartzite pebbles
			Tibbet Canyon Member		150		4			forms cliffs. To	op eroded. Lower contact sharp, regional studies indicate it is ar Marginal marine to lagoonal and paludal deposits.
			Tropic Shale			=			3.	. Smoky Hollow Mem	
											owish-gray, very fine grained to medium-grained, very thinly to dded; contains scarce small chert pebbles. Mudstone, dusky-yel-
				6			5				ive-gray, very thin bedded. Forms steep slope; lower contact interfingering. Alluvial-plain deposits.
											: mudstone, carbonaceous, gray to black, laminated to very thir nized plant fragments abundant; contains thin coal beds; forms
		/1	Dakota Formation	2	6						wer contact sharp and conformable, interfingering in nearby areas stal swamp deposits.
	Upper	Morrison Fm	-UNCONFORMITY		234	0000000000	36		4.		ember: sandstone, yellowish-gray to grayish-orange; middle and fine to medium grained, thin to thick bedded, and thinly to thickly
				546			7			to very thin be	rades downward to lower part which is very fine grained, laminated dded, and thinly crossbedded and contains several siltstone and
			Salt Wash Member	Member ORMITY			5			ginal marine an	s; fossils scarce; lower contact gradational and interfingering; mar- id beach deposits.
			—UNCONFORMITY—				8			calcareous about 2	e, bentonitic, medium-durk-gray, laminated to very thin bedded; 25–450 feet above base. Upper 50–100 feet, dusky-yellow to light-
		K	Sandstone at Romana Mesa	42	2	- Colores	7.9			white bentonite b	y very thin bedded mudstone and siltstone; forms slope. Thin teds common in lower 50 feet, uncommon above. Contains limeted to following those (in ft above base); about 550 feet, cone in
JURASSIC		Entrada Sandstone	Middle member Lower member Upper member of Carmel Formation	820	262 558	2/	10			cone structure, rai	s of the following types (in ft above base): about 550 feet, cone-in- re; 12–30 feet, fossiliferous, common; lower 10 feet, septarian, rare. rly sharp; formation generally concealed by talus; offshore marine
						7///////	1			deposits. Dakota Formation (2	
										Upper member (1	19 ft): upper 14 feet is cliff-forming sandstone, grayish-orange to n, very fine grained to fine-grained, thin-bedded to massive, fossil-
						11111				iferous at top.	Lower 5 feet is slope-forming mudstone and shale, gray, fossils very thin coquinoid marlstone lenses; middle 2 feet is moderate-
										brown very fine	grained sandstone bed. Lower contact sharp and conformable, to marine deposits.
											5 ft): mudstone, dark-gray and carbonaceous or yellowish-green, I thin coal beds; forms slope; lower contact sharp and conformable,
							12			The state of the s	ering; swamp or marsh deposits. ft): sandstone, dark-gray, irregularly flat bedded; contains carbon
	Middle	1	andstone at Page	8.	2	2222	13			unconformable;	nd scattered pebbles; forms minor ledge; lower contact sharp and fluvial and residual deposits.
			UNCONFORMITY—/				7		7.		5–250 ft): interbedded sandstone and mudstone. Sandstone, light-
SIC								BURIED ROCKS		thinly to thickly	gray, and light-brownish-gray, very fine grained to medium-grained, crossbedded and less commonly very thin bedded to thin-bedded;
JURASSIC								Drilled in map area by Romex Corp. in 1970. No. 1 Federal-	-	brown, irregularl	ered pebbles. Mudstone, grayish-yellow-green to dark-reddish- ly very thin bedded to thin-bedded. Upper 57 feet is conglomerate
TRIASSIC(?) AND JU			Navajo Sandstone					Rock Creek well in the NW¼ NW¼ sec. 19, T. 41 S., R. 7 E. Spudded in upper member of Carmel For mation, total depth 3,969 ft., bottomed in Cedar Mesa Sandstone Member of Cutler Formation.	f I I	Mountain Form	dstone that locally contains petrified logs; may correlate with Cedar lation (Lower Cretaceous) of central Utah. Lower contact fairly interfingering. Alluvial-plain deposits. Member is distinguished
					30		14			from Salt Wash	Member because it contains more mudstone and generally whiter it forms ledgy slopes.
										Salt Wash Membe	rr (305–320 ft): sandstone, very light gray, yellowish-gray, brownish- sh-yellow-green (generally weathers dark brown), very fine grained
										to medium-grain	ned, thinly to thickly crossbedded; scattered pebbles and conglom- mmon; contains several beds of grayish-yellow-green and dark-
#						<i>>>>>></i>			9.	reddish-brown ii	rregularly very thin bedded to thin-bedded mudstone; forms cliffs narp and channeled, regional studies indicate it is an unconformity;
										alluvial-plain de Sandstone at Roma	posits. na Mesa (30–105 ft): sandstone, yellowish-gray, fine-grained, very
TRIASSIC(?) PERMIAN				329							in-bedded and thickly crossbedded; scattered coarse grains com- ower contact sharp, regional studies indicate it is an unconformity;
		K	ayenta Formation				15			slightly exaggerate	ore marine deposits. Width of outcrop band on map may be ed in cliffs to show continuity. Regional studies indicate that the
						1//////	_			north in central U	
		V	Vingate Sandstone	24	19		16		10. N		150–300 ft): sandstone, very light gray, moderate-reddish-orange,
	Upper		<i>—UNCONFORMITY—</i> Owl Rock Member		127		17			and thinly to thi	eddish-brown, very fine grained, very thin bedded to thick-bedded ickly crossbedded; includes minor dark-reddish-brown mudstone y thin beds of grayish-purple bentonite; generally forms red and
		_	OWI NOOK INICITIBET			7.77.77				white banded cli	iff; lower contact conformable and locally gradational, stratigraphic tition to upper contact may vary by as much as 50 feet owing to
		mation	5							broad intraform	national folds and probably to interfingering. Probably shallow at, lagoonal, and eolian deposits. Width of outcrop band on map
		Chinle For	Petrified Forest Member	841	518	=:=:=:=	18			may be slightly	exaggerated in cliffs to show continuity. 00–650 ft): sandstone, moderate-reddish-orange, very fine grained,
										thinly to thickly	y crossbedded; contains several beds of laminated thin-bedded silty sandstone; forms smooth cliff with rounded shoulder at top;
			Shinarump Member	201	196	.0	19			posits. Large i	harp and conformable; probably eolian and nearshore marine de- irregular slumps that extend down into the upper member of the
			-UNCONFORMITY-		130	000000000000000000000000000000000000000				upper member	
	Middle(?) and Lower	IV	oenkopi Formation	26	68		20			that can be reco	s of the Entrada correlate with the lower two of three members egnized about 40 miles northwest of the map area near Escalante, er part of the middle member locally contains several sets of large-
	and Lower		UNCONFORMITY-			7777				scale cross-strat	ification and may correlate with the large-scale cross-stratified to the control of the Entrada near Escalante. These members do not correlate
	Lower		Kaibab Limestone	12	18		21	Drilled 10 miles northwest of map area by Byrd Corp. in		with the lower s	sandy, medial silty, and upper sandy members of the Entrada of izona (Harshbarger and others, 1957).
			White Rim Sandstone Member Organ Rock Member Cedar Mesa Sandstone Member		209		22		12.	sandstone, and	the Carmel Formation (140–220 ft): interbedded sandstone, silty mudstone. Sandstone, generally moderate reddish orange to
		Cutler Formation								grained, very this	ish brown although several beds are very light gray, very fine n bedded to thin-bedded and locally thinly to thickly crossbedded.
					415		23			laminated to ve	and mudstone, moderate-reddish-orange to pale-reddish-brown, rry thin bedded and ripple cross-laminated; includes scarce very
					915				12	gradational, cor	yish-purple bentonite. Lower contact generally sharp but locally nformable; forms ledgy slopes; a lower member known as the
										marine and tida	ingue is present about 25 miles west of the map area; shallow il-flat deposits, possibly lagoonal in part.
				1539					13.	reddish-brown, fin	(45–105 ft): sandstone, moderate-reddish-orange to moderate- ne-grained, very thickly crossbedded; small angular chert pebbles iff; lower contact sharp, regional studies indicate it is an uncon-
									14.	formity; eolian dep	
							24				very thickly crossbedded; forms cliff; only upper 200 feet exposed
								10,045 ft., bottomed in Bright Angel Shale.	15.		sandstone, reddish-brown to pink, fine-grained; interbedded with orange to pink siltstone and red shale; fluvial deposits.
									16.	Wingate Sandstone: and red shale; eoli	sandstone, orange, fine-grained; contains scarce orange siltstone ian deposits.
									17.	Chinle Formation: Owl Rock Member:	: interbedded shale, siltstone, and mudstone, red, orange, and pink,
									18.	Petrified Forest M	mite; lacustrine deposits. lember: interbedded shale, siltstone, and mudstone, varicolored,
							3			gray to pink lime	ains scarce thin beds of pink fine-grained sandstone and greenish- estone; fluvial and lacustrine deposits.
			Halgaito Tongue	53	32		25		19.	includes small qu	er: conglomerate and pebbly sandstone, light-gray to light-brown; uantities of grayish-green shale and siltstone; upper approximately relate with Monitor Butte Member farther east; fluvial deposits
									20.	Moenkopi Formation:	relate with Monitor Butte Member farther east; fluvial deposits. shale and siltstone, maroon, orange, and pink, micaceous; probagoons and on tidal flats.
			UNCONFORMITY-						21.		dolomite, light-brown, cherty; contains algal structures; marine
PENNSYLVANIAN	Upper and			498					22.	Cutler Formation:	one Member: sandstone, white to light-brown, fine- to medium-
	Middle	H	lermosa Formation				26		Ann Sten 4	grained; interbed	dded with smaller amounts of light-brown silty and cherty dolo- arce beds of red shale; marginal marine deposits.
									23.		er: interbedded shale, claystone, and siltstone, maroon, orange, acludes scarce beds of white, orange, and light-brown very fine
	Lower		Molas Formation	15	54		27			deposits.	rained sandstone and traces of anhydrite; probably alluvial-plain
		d)			160		28	—— Mississippian and older rocks	24.	cludes red, orang	stone Member: sandstone, white to light-brown, fine-grained; in- ge, pink, maroon, green, and light-brown siltstone, red to green
Z	Upper	mestone	Member					(modified from Munger and others, 1965).	25.	and eolian depos	e light-brown to pink silty and cherty limestone; marginal marine sits. hterbedded white to light-brown fine-grained sandstone, pink, red,
MISSISSIPPIAN		dwall Li	Mooney Falls Member	gs /ash	289	1,1,1,1	29		۷٠.	orange, and light	iterbedded white to light-brown fine-grained sandstone, pink, red, t-brown siltstone, red shale, pink and light-brown limestone, and nite; the limestone and dolomite contain algal structures. Basal
SISS			Thursday			11111					one and chert pebble conglomerate; probably alluvial plain and
MIS	Lower		Thunder Springs and Whitmore Wash Members			11/4/	30		26.	Hermosa Formation:	deposits. interbedded white, pink, and light-brown fine- to medium-grained ik, and light-brown siltstone, red shale, white to light-brown lime-
			-UNCONFORMITY-		LA	4444	21		27.	stone that contains	s algal structures, and white to red chert; marine deposits. lale, maroon, and in middle light-brown limestone that contains
DEVONIAN	Upper		Ouray(?) Limestone				31				d chert; marine and nonmarine deposits.
			Elbert Formation UNCONFORMITY——	14	1	7.7.7.7	32		28.	Horseshoe Mesa I structures, and fi	Member: limestone, light-brown to white; contains chert, algal ractures filled with red clay; marine deposits.
	Middle					IN IN		Drilled 45 miles west-southwest 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	29.	scarce thin beds	ber: dolomite, white to light-brown, crinoidal and cherty; contains of light-brown limestone; marine deposits.
			Muav Limestone		434	72777	33		30.	tains white tripol	nd Whitmore Wash Members: dolomite, white, fossiliferous; con- litic chert; marine deposits.
										to pink; contains alg	dolomite and limestone, light-brown, gray, white, and scarce red gal structures; includes thin beds of purple shale; marine deposits.
				1400					32.	cludes several thin	plomite and limestone, light-brown; contains algal structures; in- in purple to green shale beds, especially in upper 25 feet; basal 20 bb brown silty and delemitic conditions that probably correlates
CAMBRIAN										with the McCracke	ht-brown silty and dolomitic sandstone that probably correlates on Sandstone Member of Knight and Cooper (1955) farther east;
		В	right Angel Shale		676	77,777	34		33.		lomite and limestone, brown to gray, silty; contains oolites, chert,
								Limestone, total depth 6,253 ft., bottomed in Precambrian rocks.	34.	marine deposits.	al structures; includes thin red to green shale and siltstone beds; shale, silty, red, green, and gray, glauconitic, calcareous and dolo-
									54.	mitic; contains silts	shale, sitty, red, green, and gray, glauconitic, calcareous and dolo- stone and silty to pebbly sandstone. Includes gray oolitic and pel- estone and minor dolomite beds which are tongues of the Muav
						.0					e deposits. Thickness shown is corrected from regional trends
	Lower	7	apeats Sandstone		290	0.000	35		35.	grained, feldspathio	sandstone, pebbly, gray to reddish-brown, medium- to coarsec and glauconitic; contains thin red to green shale beds; marginal
			UNCONFORMITY			The second secon				marine deposits.	





ECONOMIC GEOLOGY

INTRODUCTION

Most of the quadrangle 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 17 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 quadrangle, rose from approximately 3,450 feet to 3,600 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.

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 5 or more miles west of the map area in the main part of the Kaiparowits coal field.

A nearly complete section of the Straight Cliffs Formation measured 1,000-2,000 feet east of the quadrangle is included as section A of the coal sections for comparison. Only the thin coal bed at the top of the Christensen coal zone of the John Henry Member extends into the map area. The Smoky Hollow Member is largely covered in the area, but on the basis of correlation from section A to another section that was measured several miles north of the map area, the thin coal bed at the base is probably continuous through the northeastern part. Coal (on an as-received basis) in the Straight Cliffs Formation probably has a heating value of 10,000-12,000 British thermal units based on analyses of coal taken from abandoned mines about 16-18 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 (on an as-received basis) probably has a heating value of about 10,000-11,000 British thermal units based on an analysis of coal taken from an abandoned mine about 15 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 northern part of the quadrangle is a fairly large structure that offers potential for oil and gas development.

One dry hole was drilled on this fold in 1970 by 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 formations 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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GEOLOGIC MAP AND COAL RESOURCES OF THE NORTHWEST QUARTER OF THE CUMMINGS MESA QUADRANGLE, KANE COUNTY, UTAH

1973