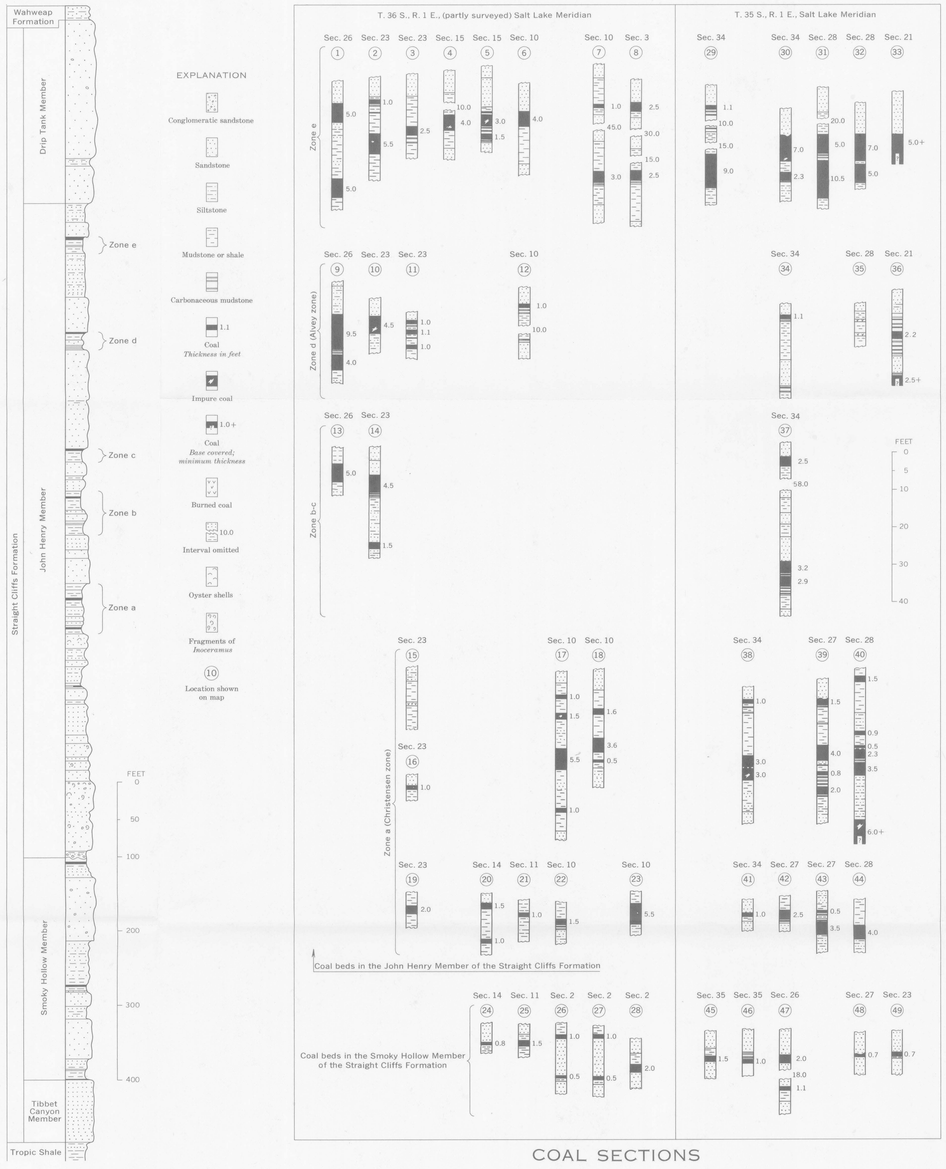
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

COAL INVESTIGATIONS
MAP C-60 (SHEET 2 OF 2)

GENERALIZED SECTION OF THE
STRAIGHT CLIFFS FORMATION



COAL SECTIONS

GENERALIZED COLUMNAR SECTION

SYSTEM	SERIES	FORMATION AND MEMBER	THICKNESS (ft)	LITHOLOGY	DESCRIPTION
QUATERNARY	Holocene and Pleistocene	Surficial deposits			Surficial deposits of alluvium, colluvium, slope wash, and talus. Alluvium: silt, sand, and gravel in valleys, locally entrenched more than 50 feet by present drainage channels; includes some colluvium and coarse alluvial-fan deposits in tributaries of Upper Valley Creek. Colluvium and slope wash: poorly sorted silt, sand, gravel, and angular fragments of bedrock; includes some areas where bedrock is obscured by soil, vegetation, and slump or slide debris. Talus deposits: angular fragments and blocks of latite in northwest corner of quadrangle. Valley fill: slightly older alluvium, colluvium, and alluvial-fan deposits mostly along present drainage course but as much as 200 feet above present drainage; includes some slope wash on steep slopes of Escalante Mountains and locally some flash-flood and mudflow deposits; may include thin veneer of sand and gravel on surfaces cut on older valley fill. Terrace gravels: thin remnants of stream deposits composed mostly of rounded pebbles and cobbles of quartzite and limestone. Older valley fill: older alluvium, colluvium, and alluvial-fan deposits as much as 400 feet above present drainage; deposits mostly poorly consolidated but locally well cemented by caliche; includes some older slope wash and slump and landslide deposits on steeper slopes and undivided remnants of terrace and pediment deposits. Older surficial deposits of Canaan Peak: partly consolidated deposits on slopes north of Canaan Peak, which lies just south of the quadrangle; mostly poorly sorted subangular to subrounded pebble- to boulder-size fragments of white limestone derived from the Wasatch Formation in a limy mudstone or sandstone matrix; at lower altitudes includes pebbles and cobbles derived from the Canaan Peak Formation; locally includes large angular blocks of white limestone as much as 30 feet long and 20 feet wide. Highest surficial remnants: deposits of sand and gravel of uncertain origin on ridges as much as 600 feet above present drainage.
		Unconformity			
TERTIARY	Miocene(?)	Tuff of Osiris	200–600		Latite, light- to medium-gray, porphyritic; mostly densely welded ash-flow tuff; contains abundant sanidine phenocrysts. Base mostly obscured by talus. Equivalent to the tuff of Osiris in the Salina quadrangle (P. L. Williams, oral comm., 1970; Williams and Hackman, 1971).
		Unconformity			
	Eocene	Wasatch Formation: Variegated sandstone member	About 280		Sandstone, siltstone, mudstone, and limy mudstone, pink to red, soft; interbedded with white to gray fine- to coarse-grained sandstone; a basal conglomerate (10–30 ft) contains well-rounded pebbles of abundant black chert, light quartzite, and gray limestone. Thickens northwestward, and 10 miles northwest of quadrangle is more than 600 feet thick and is overlain by several hundred feet of white tuffaceous sediments beneath the latite flows. Mostly covered by debris from overlying volcanic rocks.
		White limestone member	500–550		Limestone, white to light-gray, very fine granular to microcrystalline; contains thin yellowish-gray mudstone interbeds in middle and lower parts; some beds contain probable early to middle Eocene fresh-water gastropods. Thins eastward north of the quadrangle and grades laterally into pink clastic limestone and limy mudstone. Forms white cliffs with narrow benches or steep forested slopes.
	? Paleocene	Pink limestone member	800–850		Limestone, pink, pale-orange, light-gray, and white, commonly mottled pink or yellow, irregularly bedded to massive, very fine grained to fine-grained, clastic; contains thin gray to red limy mudstone interbeds; locally contains lenticular fine- to coarse-grained calcareous sandstone and thin (1–6 ft) dark-gray microcrystalline limestone beds containing dark shell fragments; overall pink color of member produced by stain from interbedded red units. Forms pink cliffs, columns, and spires where deeply eroded, or steep forested slopes.
		Local unconformity			
TERTIARY(?)	Paleocene(?)	Pine Hollow Formation	350–400		Mudstone and claystone, gray, purplish-gray, or red. Mudstone is commonly arenaceous or calcareous, grading to light-gray or white argillaceous or silty limestone. Claystone is bentonitic in places, particularly near middle of formation. Contains interbeds of gray, tan, or red fine- to coarse-grained sandstone, mostly in lower part; thin conglomerate lenses common near base. Overall color of formation ranges from pale purplish gray to bright red. Poorly exposed in quadrangle and forms gentle to moderate slopes mostly covered by soil and vegetation. Lower contact locally marked by unconformity or disconformity. Lower part intertongues with Canaan Peak Formation west of quadrangle. Wedges out to northeast over Dutton monocline north of the quadrangle, but nature of wedge out obscured by surficial deposits. West of quadrangle, this formation, formerly included in the Wasatch Formation, is separated from the pink limestone member of the Wasatch by an unconformity.
	? Paleocene(?)	Local unconformity			
		Canaan Peak Formation	600–900		Sandstone, conglomeratic sandstone, and conglomerate interbedded; tan, pink, or red near top to light-brown or gray in lower part; contains multicolored rounded pebbles, cobbles, and small boulders of quartzite, chert, dense to porphyritic acidic igneous rocks, and minor amounts of gray limestone; some boulders exceed 12 inches in diameter. Type section south of quadrangle yielded Late Cretaceous (Campanian) palynomorphs. Poorly exposed and forms steep gravel-covered slopes. Base unconformable on Kaiparowits Formation. North of quadrangle beds are deformed along steep limb of Dutton monocline and wedge out to northeast on north end of Dutton monocline where contacts are obscured by surficial deposits. This coarse clastic unit, formerly considered to be the basal conglomerate of the Wasatch Formation, is unconformable on the Kaiparowits Formation and west of the quadrangle is unconformable beneath the pink limestone member of the Wasatch Formation.
		Unconformity			
CRETACEOUS	Upper	Kaiparowits Formation	2,200–2,700		Sandstone, greenish- to brownish-gray, very fine grained to fine-grained, friable, "salt and pepper"; contains subordinate thin light-gray mudstone and buff to brown moderately resistant lenticular fine- to medium-grained sandstone interbeds; dinosaur bones, turtle shells, and fresh-water molluscs common in some beds; upper part yielded Late Cretaceous (Campanian) palynomorphs. Poorly exposed except in southwestern part of quadrangle and forms gentle slopes covered by surficial deposits. Base conformable and gradational with Wahweap Formation.
		Wahweap Formation	1,150–1,200		Sandstone, light-gray to white, fine- to coarse-grained, thick bedded to massive, crossbedded, in upper 250–500 feet; contains gray shale interbeds and grades into Kaiparowits Formation in upper 100 feet. Sandstone, light- to dark-brown, fine- to medium-grained, crossbedded, lenticular, and interbedded gray mudstone in lower 650 feet. Formation forms low cliffs or hogbacks, benches, and slopes. Base is conformable on Straight Cliffs Formation.
		Straight Cliffs Formation: Drip Tank Member	200–250		Sandstone, light-gray to white, medium- to coarse-grained, locally conglomeratic, massive, crossbedded, cliff-forming.
		John Henry Member	900–950		Sandstone, mudstone, carbonaceous mudstone, and coal. Sandstone is light gray to light brown, very fine grained to coarse grained, and crossbedded. Mudstone is olive gray to light brown. Carbonaceous mudstone is dark gray to black. Upper part contains the major coal resources in quadrangle. Massive sandstone bed in lower part contains pebble conglomerate lenses and fragments of *Inoceramus* shells. Base contains thin pebble conglomerate unconformable on Smoky Hollow Member.
		Unconformity			
		Smoky Hollow Member	300		Sandstone, light-gray to light-brown, fine- to coarse-grained, thin bedded to massive, locally conglomeratic; contains mudstone or carbonaceous mudstone and thin coal beds in upper and lower parts.
		Tibbet Canyon Member	80–100		Sandstone, light-brown, fine-grained, partly crossbedded, marine.
		Tropic Shale	600–700		EXPOSED SUBSURFACE[1] Shale, medium- to olive-gray, marine; contains thin grayish-orange fine-grained sandstone interbeds in upper 100 feet and some thin beds of bentonite and limestone concretions near base. Upper part mostly covered by rubble from Straight Cliffs Formation; lower part not exposed in quadrangle.
		Dakota Formation	120–160		Sandstone, grayish-orange; interbedded with light-olive-gray shale in upper half; coal beds may be present in about middle of formation; brownish-black carbonaceous claystone, shale, and siltstone and some beds of grayish-orange sandstone in lower half; at some places conglomerate occurs at base.
	Lower(?)	Unconformity			

[1] Subsurface data modified after Zeller (1973)

Continued above

Continued from below

JURASSIC	Upper	Morrison Formation	30–150	Sandstone and conglomerate, gray; pebbles of red chert, limestone, petrified wood, and quartzite in upper part; light-gray massive fine-grained sandstone and interbedded greenish-gray and reddish-brown shale in lower part. May be cut out by pre-Dakota erosion.
		Summerville Formation	60–110	Claystone and siltstone, mottled dark-reddish-brown and grayish-olive; 1- to 2-foot-thick dense gray partially recrystallized limestone 16 feet from top. Recent work by Fred Peterson (oral commun., 1970) indicates that rocks mapped as Summerville may belong to the Morrison Formation. May be cut out by pre-Dakota erosion.
		Entrada Sandstone	950–1,000	Sandstone, light-gray to very pale orange, fine-grained, crossbedded, massive, in upper 250 feet; interbedded reddish-brown sandstone and red and gray shale in middle 400 feet; reddish-brown silty sandstone in about basal 350 feet.
	Upper and Middle	Carmel Formation	490–590	Siltstone and claystone, mottled reddish-brown to greenish-gray; thin-bedded crinkly yellowish-gray limestone in upper part; pale-reddish-brown calcareous siltstone containing some interbeds of limestone and shale in lower part. Thousand Pockets Tongue of Navajo Sandstone may be included with lower part.
TRIASSIC(?) AND JURASSIC		Navajo Sandstone	1,500–1,550	Sandstone, grayish-orange, medium- to fine-grained, massive, cliff-forming; large-scale festoon crossbedding.
TRIASSIC(?)	Upper	Kayenta Formation	250–320	Sandstone, reddish-brown, thin- to thick-bedded, and interbedded siltstone.
TRIASSIC	Upper	Wingate Sandstone	200–260	Sandstone, reddish-orange to reddish-brown, fine-grained, crossbedded, massive.
		Unconformity		
		Chinle Formation	440–460	Claystone, variegated greenish-gray and grayish-red, bentonitic; interbedded with pale-red to reddish-orange sandstone; some conglomerate near base.
		Shinarump Member	60–100	Sandstone, light-gray, medium-grained, crossbedded.
		Unconformity		
	Lower and Middle(?)	Moenkopi Formation	800–880	Sandstone, shale, and siltstone, reddish-brown.
		Timpoweap Member	60–70	Dolomite, tan to buff; oil-stained in part; contains a thin gray siltstone parting.
		Unconformity		
PERMIAN	Lower	Kaibab Limestone	140–200	Dolomite, light-gray to tan; contains abundant chert; fractures and vugs are oil saturated. Contains main oil-producing zones of Upper Valley oil field.
		White Rim Sandstone Member of Cutler Formation	140–170	Sandstone, light-gray, dolomitic; some interbedded light-brown dolomite.
		Toroweap Formation	360–420	Dolomite, light-brown, dense; interbedded light-gray sandstone, oil-stained in part; interbedded anhydrite throughout.
		Cutler Formation: Organ Rock Member	140–160	Siltstone, light-gray to light-red; some brown oil-stained sandstone.
		Cedar Mesa Sandstone Member	1,350–1,400	Sandstone, light-gray to buff, fine- to medium-grained. Lower one-third contains interbedded tan to buff limestone and dolomite.
		Unconformity		
PENNSYLVANIAN		Hermosa Formation	340	Sandstone, light-gray; interbedded buff dolomite and reddish- and purplish-gray siltstone.
		Molas Formation	40–70	Shale, reddish-gray; some limestone concretions and sandstone.
		Unconformity		
MISSISSIPPIAN	Lower and Upper	Redwall Limestone	900	Limestone and dolomite, light-gray to buff. Extensive karst topography at top. Many cavernous intervals.
DEVONIAN	Lower	Ouray Limestone	160	Limestone, buff, dense.
CAMBRIAN	Upper		230	Dolomite, buff; some interbedded sandstone and greenish-gray shale.
		?Unconformity?		
			100	Dolomite, buff; and interbedded greenish- and reddish-gray shale.

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GEOLOGY

INTRODUCTION

The Upper Valley quadrangle lies in central Garfield County in southern Utah. Most of the fieldwork in the area was done in the summers of 1966 and 1967 as part of the U.S. Geological Survey's program for classifying Federal lands withdrawn for coal. Mapping was done on U. S. Geological Survey topographic maps at a scale of 1:24,000 with the aid of Geological Survey aerial photographs at a scale of 1:49,000.

GEOGRAPHY

The area lies in the northern part of the Kaiparowits Plateau about 10 miles southwest of the town of Escalante, Utah, and includes the southeast edge of the Table Cliff Plateau. Altitudes range from about 6,500 feet to nearly 10,500 feet. Much of the area is drained by Upper Valley Creek and its tributaries, which carry water to the Escalante River. Utah Highway 54 between Henrieville and Escalante extends diagonally through the center of the quadrangle from southwest to northeast. The nearest railhead is at Marysvale, Utah, about 85 miles to the northwest. Much of the quadrangle is within the Dixie National Forest. Pinyon and juniper forests on the lower slopes give way to pine, fir, and aspen at higher altitudes. The climate is mostly semiarid but varies considerably with altitude.

STRATIGRAPHY

Sedimentary rocks exposed in the quadrangle total about 7,500 feet in thickness and range in age from Late Cretaceous to early Tertiary. About 9,500 feet of sedimentary rocks are present in the subsurface. The exposed sedimentary rocks are capped by a few hundred feet of Miocene(?) volcanic rocks, of which only the southernmost exposure is present in the northwest corner of the quadrangle. Large areas of the quadrangle are covered by Quaternary surficial deposits.

The lithology and the thickness of stratigraphic units are shown in the generalized columnar section.

STRUCTURE

The major structural feature in the quadrangle is the Dutton monocline (Upper Valley monocline of Kelley, 1955), a northwest-trending fold with dips as much as 40° westward on the steep flank. Structural relief on the fold is more than 4,500 feet. The monocline extends northward beneath Tertiary rocks of the high plateaus north of the quadrangle.

East of the anticlinal bend of the monocline, Cretaceous and older rocks are warped into broad, gentle north- or northwest-trending folds with dips generally 10° or less but locally as much as 20°. The most conspicuous of these folds is the doubly plunging Upper Valley anticline, which lies just east of the anticlinal crest of the Dutton monocline in the northeastern part of the quadrangle. West of the synclinal bend of the monocline, Upper Cretaceous and older beds dip as much as 12° into a relatively broad northwest-trending fold, the Table Cliff syncline, which passes beneath the Table Cliff Plateau. The Tertiary beds in the Table Cliff Plateau seem to be slightly warped into a syncline much shallower than the Table Cliff syncline but on approximately the same trend. The Tertiary beds show a gentle regional tilt toward the northwest.

In most of the quadrangle structure contours were drawn on the top of the Smoky Hollow Member of the Straight Cliffs Formation by projection from the top of the Straight Cliffs or Wahweap Formation.

ECONOMIC GEOLOGY

COAL

The coal-bearing John Henry Member of the Straight Cliffs Formation (Peterson, 1969) is exposed in the eastern part of the quadrangle, mostly along the steep limb of the Dutton monocline. In the structural basin to the west it lies in the subsurface at various depths beneath younger Cretaceous and Tertiary rocks. A summary of data pertaining to the coal deposits of the entire Kaiparowits coal field is given by Doelling (1970).

An attempt was made to map all coal beds in the quadrangle more than 14 inches thick and major burned zones that indicate the presence of coal at depth.

The coal-bearing interval, about 500 feet thick, is divided into five major coal-bearing zones that seem to be fairly persistent through the area, separated by intervals barren of coal that commonly consist of massive sandstone. Coal zones may contain several coal beds ranging in thickness from a few inches to 14 feet and separated by carbonaceous mudstone, mudstone or thin sandstone beds. Coal zone a is probably equivalent to the Christensen zone, and zones d and e are probably equivalent to the Alvey zone in the Canaan Creek quadrangle (Zeller, 1973).

Quality.—Analyses of seven samples collected north of the quadrangle from outcrops on Cherry Creek prior to 1928 (Grose and others, 1967, p. 77) show calorific values ranging from 7,420 to 9,995 Btu (British thermal units) per pound on an as-received basis. These values are probably low because the samples were collected from outcrops. A fresher channel sample from the Cherry Creek Mine (Robison, 1964, p. 25, sample 28) gave values of 11,920 Btu per pound on an air-dried basis and 10,125 Btu per pound on an as-received basis and is undoubtedly more representative of the unweathered coal. In general, the Kaiparowits coal falls within the range of high-rank subbituminous to low-rank volatile bituminous, is low to moderate in ash content, and is low in sulfur.

Resources.—Calculation of coal resources in the area is complicated by lenticular coal beds, limited exposures, and large areas of burned coal.

An estimate of the coal in the John Henry Member in beds more than 1 foot thick is given in table 1. The estimate is made for an area east of a line where coal zone a is less than 2,500 feet below the surface. No calculations were made for greater depths because of the absence of subsurface data. Considerable coal is undoubtedly present in the basin to the west at depths of 3,000–4,500 feet in much of the quadrangle and as much as 7,000 feet below the surface in the northwest. Thick coal beds crop out in the Straight Cliffs Formation on the west side of the basin a few miles west of the quadrangle, indicating the probable presence of large coal resources at depth in the basin.

Inferred resources were calculated by multiplying the approximate acreage containing coal by the estimated total coal thickness to obtain volume of coal in acre-feet; an average of 1,770 tons per acre-foot for subbituminous coal was used to compute tonnage. Where only burned coal beds are evident on the outcrop, a burned bed was given an estimated minimum thickness based on the extent and thickness of the clinker zone. In burned areas coal is presumed to be present 100 feet back from the outcrop. On narrow ridges or where overburden is thin, the coal may be burned entirely.

OIL AND GAS

The map area includes the northwest end of the Upper Valley Oil Field. The Tenneco Oil Co. is producing oil mainly from the Kaibab Limestone (Permian) on the Upper Valley anticline. The first producing oil well was completed in 1964, and the field produced about 3 million barrels through 1969.

Five test holes drilled for oil and gas in the quadrangle include one producing well, Tenneco Oil Co. Upper Valley 14, in sec. 11, T. 36 S., R. 1 E. Most of the current production in the Upper Valley field occurs just east of the southeast quarter of the quadrangle in the Canaan Creek quadrangle (Zeller, 1973).

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GEOLOGIC MAP AND COAL RESOURCES OF THE UPPER VALLEY QUADRANGLE, GARFIELD COUNTY, UTAH

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