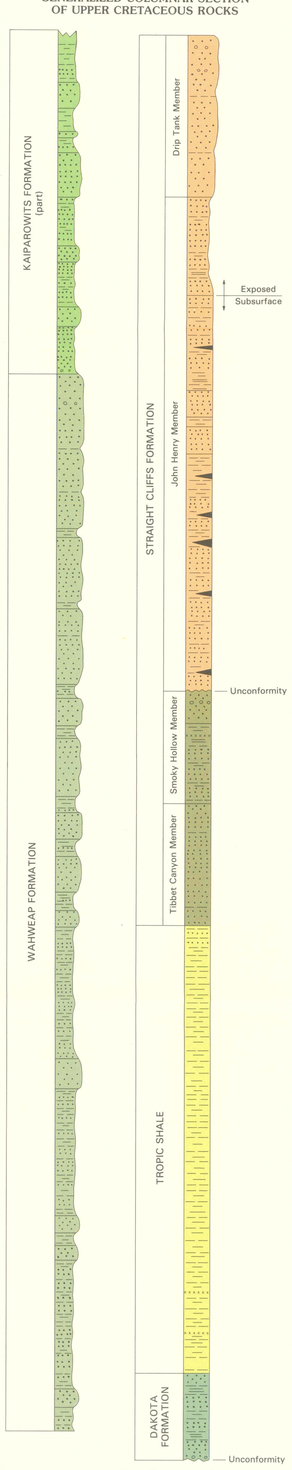
DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

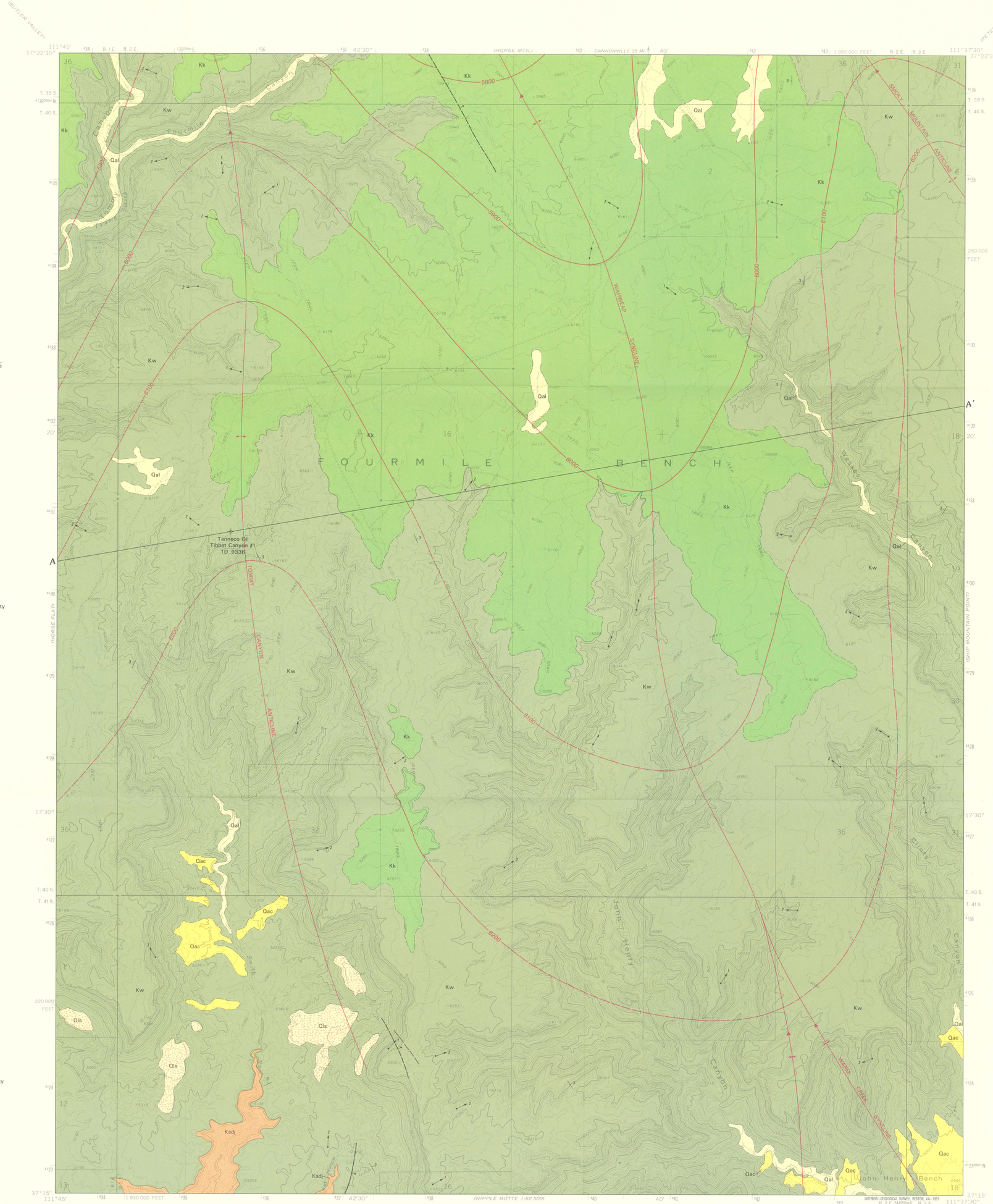
COAL INVESTIGATIONS
MAP C-140

GENERALIZED COLUMNAR SECTION OF UPPER CRETACEOUS ROCKS



EXPLANATION

- Conglomeratic sandstone or conglomerate
- Sandstone
- Interbedded sandstone and mudstone
- Shale, mudstone, or claystone
- Carbonaceous shale or mudstone
- Bentonitic claystone or bentonite
- Lenticular coal beds



Base from U.S. Geological Survey, 1968
10,000-foot grid based on Utah coordinate system, south zone
1000-meter Universal Transverse Mercator grid ticks, zone 12

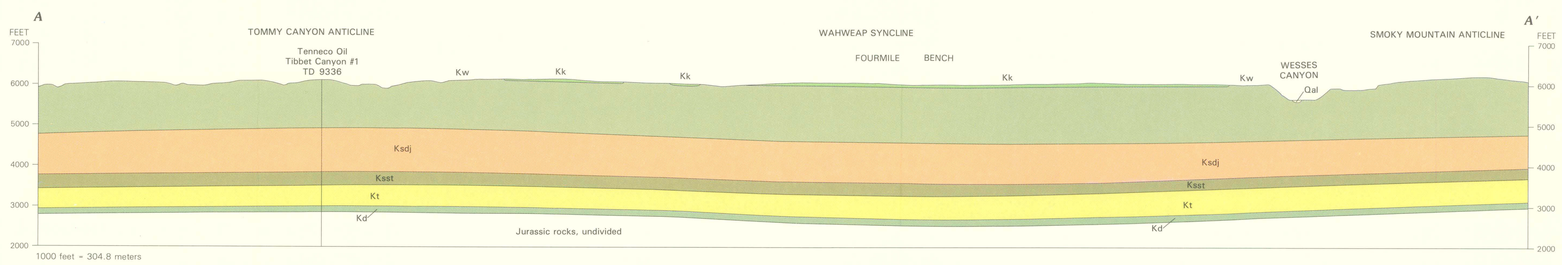
APPROXIMATE MEAN DECLINATION, 1991

SCALE 1:24 000
1 ½ 0 1 MILE
1 .5 0 1 KILOMETER
CONTOUR INTERVAL 40 FEET
DASHED LINES REPRESENT 20-FOOT CONTOURS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

UTAH
QUADRANGLE LOCATION

INTERIOR—GEOLOGICAL SURVEY, RESTON, VA—1991

Geology mapped in 1974 and 1987
Manuscript approved for publication July 12, 1990



GEOLOGIC MAP OF THE FOURMILE BENCH QUADRANGLE, KANE COUNTY, UTAH

By
William E. Bowers
1991

CORRELATION OF MAP UNITS

Qal, Qac, Qls	Holocene to Pleistocene	QUATERNARY
Unconformity		
Kk, Kw, Ksdj	Upper Cretaceous	CRETACEOUS
Unconformity		
Ksst, Kt, Kd	Upper Cretaceous	CRETACEOUS

DESCRIPTION OF MAP UNITS

Qal **Alluvium (Holocene)**—Unconsolidated to poorly consolidated, tan to brownish-gray clay, silt, sand, and gravel; includes some colluvium, slopewash, and coarse-grained flood deposits in narrow canyons. Thickness 5–30 ft

Qac **Alluvium and colluvium (Holocene and Pleistocene)**—Moderately consolidated, tan to brownish-gray silt, sand, and gravel; includes remnants of alluvial fans and some slump, landslide, and rockfall debris. Thickness 5–50 ft

Qls **Landslide deposits (Holocene and Pleistocene)**—Moderately to well consolidated slide, slump, and rockfall debris derived from cliffs of Wahweap Formation; includes some colluvium and slopewash. Thickness 5–80 ft

Kk **Kaiparowits Formation (Upper Cretaceous)**—Brownish- to greenish-gray, very fine grained to fine-grained, friable, salt-and-pepper sandstone; contains subordinate interbeds of gray to tan, lenticular mudstone and brownish-gray, fine- to medium-grained, ledge-forming sandstone. Reptile bones and freshwater mollusks occur locally. Only lower 250 ft present in quadrangle; about 1,600 ft thick just north of quadrangle

Kw **Wahweap Formation (Upper Cretaceous)**—Upper 200 ft is light-gray to white, fine- to coarse-grained, locally conglomeratic, massive, cliff-forming sandstone. Middle 500–600 ft is tan to light-brown, fine- to medium-grained, ledge-forming sandstone; contains subordinate interbeds of tan to brownish-gray, lenticular mudstone. Lower 500–600 ft is gray to tan, slope-forming mudstone; contains subordinate interbeds of tan to light-brown, fine- to medium-grained, lenticular, ledge-forming sandstone. About 1,200–1,400 ft thick

Straight Cliffs Formation (Upper Cretaceous)

Ksdj **Drip Tank and John Henry Members, undivided**—Upper 150–250 ft is light-gray to white, fine- to coarse-grained, crossbedded, cliff-forming sandstone; locally contains pebble lenses, mostly in upper part. Lower 550–700 ft is tan to brownish-gray, fine-grained sandstone and interbeds of mudstone, carbonaceous mudstone, and coal. Unit probably contains potentially commercial coal beds at depth, mostly in eastern part of map area. Unconformably overlies Smoky Hollow Member. Thickness 700–900 ft

Ksst **Smoky Hollow and Tibbet Canyon Members, undivided**—Shown in cross section only. Upper half is white to light-gray, medium- to coarse-grained, locally conglomeratic sandstone; crossbedded at top; underlain by interbedded fine-grained sandstone, mudstone, and carbonaceous mudstone or thin coal beds. Lower half is tan to brownish-gray, fine-grained, marginal marine sandstone. Intertongues with underlying Tropic Shale. Thickness 250–320 ft

Kt **Tropic Shale (Upper Cretaceous)**—Shown in cross section only. Light-gray to olive-gray marine shale; contains interbeds of thin, very fine grained sandstone in uppermost part. Thickness 500–700 ft

Kd **Dakota Formation (Upper Cretaceous)**—Shown in cross section only. Interbedded sandstone, mudstone, carbonaceous mudstone, and thin coal beds; locally conglomeratic at base. Unconformably overlies Jurassic rocks. Thickness 100–160 ft

Contact—Dashed where approximately located or inferred

Fault—Dashed where approximately located. Bar and ball on downthrown side

Lineament—Probable fault; direction or amount of displacement unknown

Anticline—Showing crest line and direction of plunge. Approximately located

Syncline—Showing trough line and direction of plunge. Approximately located

Strike and dip of beds

Component of dip of beds

Dry oil and gas test hole—Showing operator, name, and total depth (TD) in feet

6000 **Structure contour**—Drawn on top of Wahweap Formation. Approximately located; dashed where projected above land surface. Contour interval 100 ft

CONVERSION FACTORS

Multiply	By	To obtain
inches (in)	2.54	centimeters (cm)
feet (ft)	0.3048	meters (m)
miles (mi)	1.609	kilometers (km)

INTRODUCTION

The Fourmile Bench quadrangle was mapped as part of the U.S. Geological Survey's program for classifying and evaluating mineral lands of the Public Domain. Coal is the principal economic resource in the area, and much of the quadrangle is within the Kaiparowits Plateau Known Recoverable Coal Resource Area (KRCRA), an area that by definition contains coal beds 4 ft or more thick under less than 3,000 ft of overburden. The quadrangle is in the west-central part of the Kaiparowits Plateau about 28 mi south-southwest of Escalante and about 20 mi southeast of Henrieville.

Easiest access to the Fourmile Bench quadrangle is from the west via The Gut road, a graded dirt road that leaves the Cottonwood Wash road near Grosvenor Arch and crosses the Wahweap Creek drainage into the northeast quarter of the quadrangle. Much of the quadrangle is cut by steep-walled canyons as much as 1,000 ft deep; the heads of these canyons rise on the subdued topography of Fourmile Bench proper, which occupies the northern and central parts of the quadrangle.

In the southern and eastern parts of the quadrangle John Henry and Wesses Canyons drain southward into Warm Creek and then into Lake Powell on the Colorado River. Tommy Canyon in the northwest and Smith Run in the southwest drain into Lake Powell via Wahweap Creek. The area is administered by the U.S. Bureau of Land Management and parts of the area are used seasonally for grazing of livestock.

Earliest geologic work in the Kaiparowits region was done by Gregory and Moore (1931). Doelling and Graham (1972) produced a comprehensive report on the coal fields of southern Utah, including the Kaiparowits Plateau. Peterson (1969) described and named four members of the coal-bearing Straight Cliffs Formation (Upper Cretaceous). Adjacent quadrangles northeast and east of the Fourmile Bench quadrangle have been mapped in detail by Zeller (1973, 1990) and Zeller and Vaninetti (1990). Adjacent areas north and northwest of Fourmile Bench were mapped by Bowers (1972, 1981, 1983, in press).

COAL

Although no coal-bearing rocks crop out in the quadrangle, extensive drilling and sampling of coal by private energy companies in areas to the east and northeast indicate large amounts of coal at depth (Zeller, 1990; Zeller and Vaninetti, 1990). Several coal test holes have been drilled along the eastern border of the quadrangle but, due to the proprietary nature of the information, data are not available for evaluation of coal deposits in the subsurface within this part of the quadrangle.

Northeast and east of the Fourmile Bench quadrangle, coal beds of mineable thickness and quality occur in three major coal zones within the John Henry Member of the Straight Cliffs Formation. Individual coal beds within these zones are lenticular and eventually pinch out or grade laterally into carbonaceous shale or mudstone. The coal beds are more persistent on a trend of about N. 20° W., parallel to the Late Cretaceous seaway paleoshoreline (Zeller, 1990). In general a southwestward decrease in total coal would be expected in the quadrangle.

Data are not available for evaluation of subsurface coal in the western part of the quadrangle either. An oil and gas test, the Tibbet Canyon #1 drilled near the head of Smith Run, did not yield geophysical logs adequate to evaluate coal beds in the test hole. The drill hole is located just outside the boundary of the Kaiparowits KRCRA.

Where the coal-bearing rocks crop out along the East Kaibab monocline, about 7 mi west of the quadrangle, coal occurs only in the lower part of the John Henry Member of the Straight Cliffs Formation. There the coal beds are thin, generally less than 3 ft thick, and are interbedded with carbonaceous mudstone. The coal-bearing intervals shown on the generalized columnar section are representative of the eastern part of the quadrangle only.

The structure contours shown on the map are drawn on the top of the Upper Cretaceous Wahweap Formation. The highest coal beds in the Straight Cliffs Formation should occur about 1,700 ft below the top of the Wahweap Formation. The uppermost beds of the Straight Cliffs Formation are exposed only in the extreme southwest corner of the quadrangle.

Coal beds of the Straight Cliffs Formation in the Kaiparowits Plateau coal field are generally ranked as subbituminous A, are low in sulfur and ash, and are nonagglomerating (Zeller, 1990; Zeller and Vaninetti, 1990). No analyses are available for coal in the Fourmile Bench quadrangle. A U.S. Geological Survey test hole drilled about 14 mi north of the quadrangle yielded core samples of coal from three major coal zones in the John Henry Member of the Straight Cliffs Formation. The samples averaged (as received) 20 percent moisture, 34 percent volatile matter, 38 percent fixed carbon, 7 percent ash, and 0.8 percent sulfur, and produced an average heating value of 9,600 Btu/lb (Zeller, 1979).

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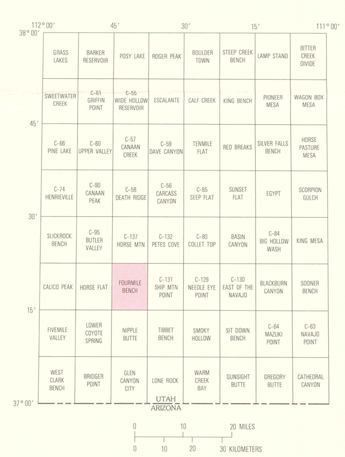

INDEX OF SOUTH-CENTRAL UTAH SHOWING LOCATION OF FOURMILE BENCH QUADRANGLE, 1:24,000-SCALE QUADRANGLE NAMES, AND NUMBERS OF PUBLISHED U.S. GEOLOGICAL SURVEY COAL INVESTIGATIONS (C) MAPS

For sale by U.S. Geological Survey, Map Distribution, Box 25286, Federal Center, Denver, CO 80225