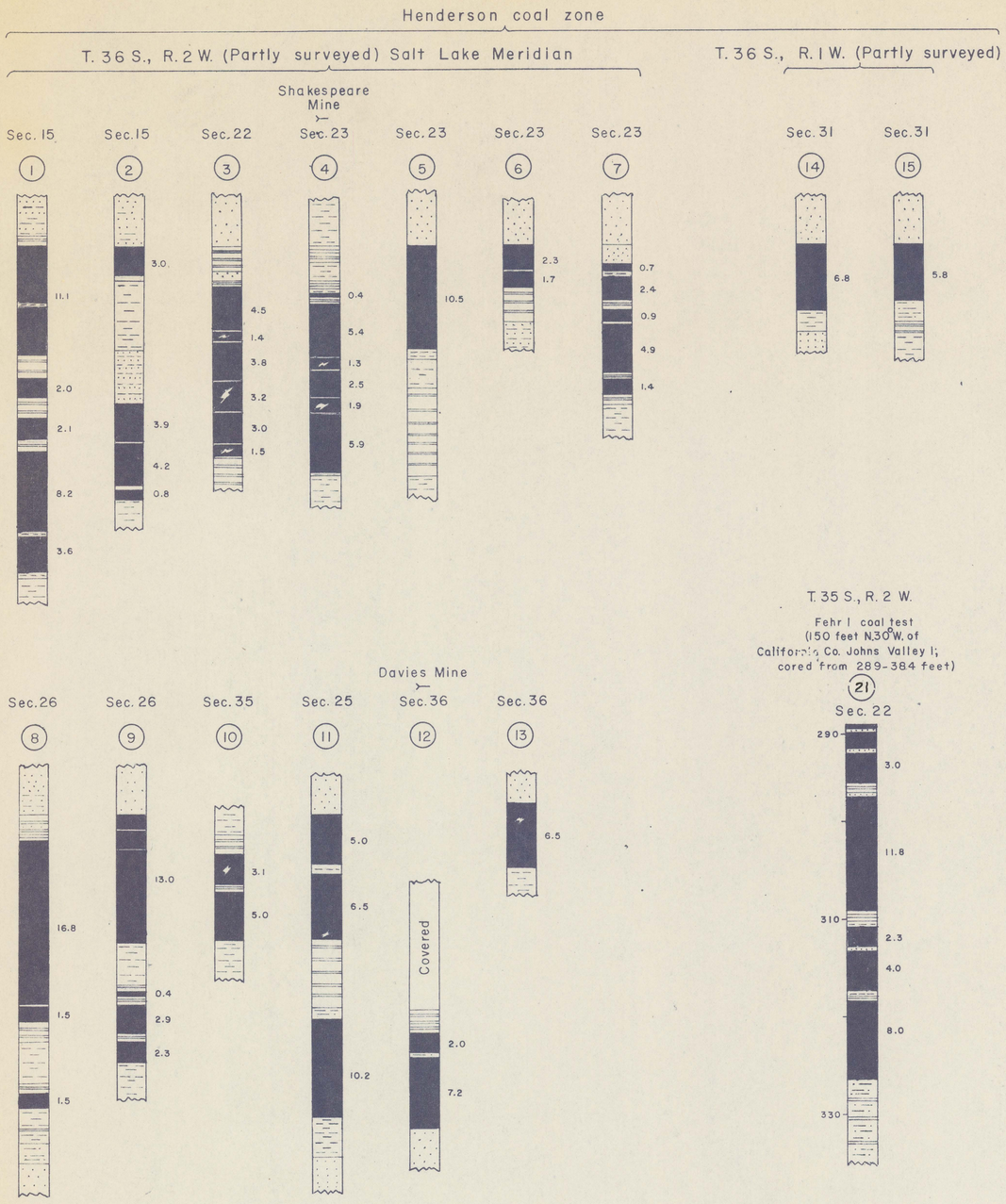

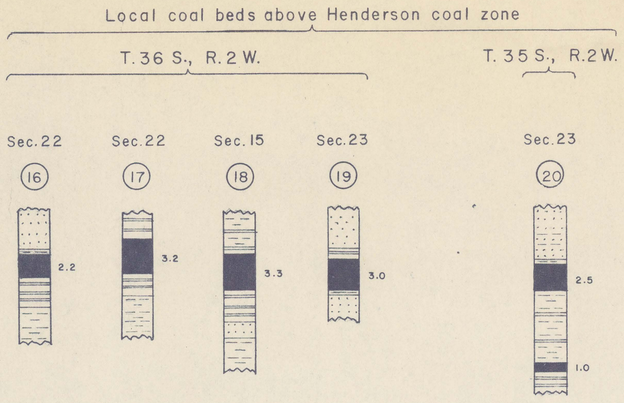

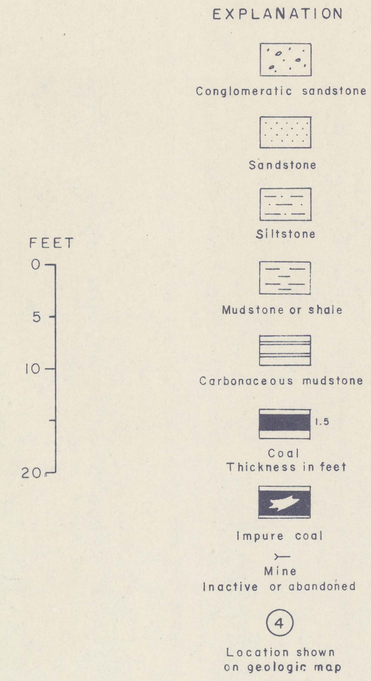

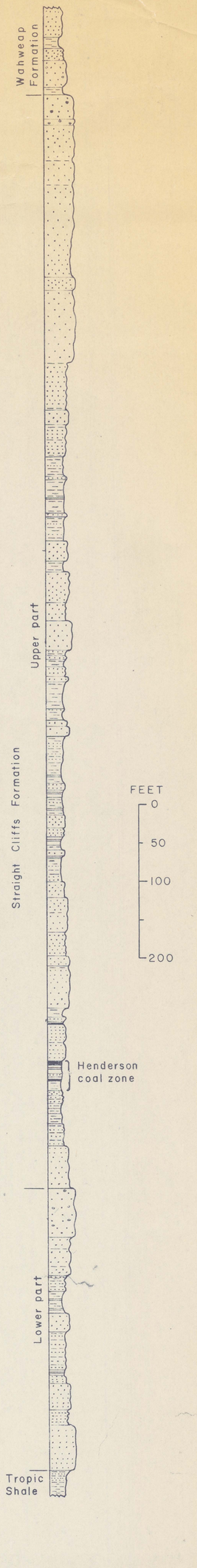

MEASURED COAL SECTIONS IN THE PINE LAKE QUADRANGLE, GARFIELD COUNTY, UTAH

GEOLOGY

The Pine Lake quadrangle lies in central Garfield County in southern Utah and was mapped in 1967 and 1968 as part of the U.S. Geological Survey's program of classifying and evaluating Federal lands withdrawn for coal.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 aerial photographs of about 1:49,000 scale.

GEOGRAPHY

The quadrangle lies about 5 miles north of Henrieville, Utah, and about 4 miles east of Tropic, Utah, and includes the southern and western parts of the Table Cliff Plateau. Altitudes range from 6,500 feet in the southwest corner to nearly 10,300 feet on the Table Cliff Plateau in the northeast quarter of the quadrangle.

Much of the southeastern, southwestern, and central parts of the area is highly dissected by steep, narrow canyons that drain south and west to the upper Paria River. The northwestern part of the quadrangle is largely an area of mature topography characterized by broad valleys and gentle to moderate slopes; drainage is to the north and west toward the east fork of the Sevier River. A few square miles on the east-central edge of the quadrangle has eastward drainage toward the Escalante River.

Access to the northern part of the area is by a U.S. Forest Service road to Pine Lake from Utah Highway 22 which is a graded road between Bryce Canyon and Antimony, Utah. Access to the southwestern part of the quadrangle is by graded road from Tropic or by unimproved roads from paved Utah Highway 54 between Henrieville and Escalante. The nearest railhead is at Marysvale, Utah, about 80 miles northwest.

The north half of the quadrangle is within the Dixie National Forest from which some saw timber of pine and fir has been harvested. Most of the south half of the quadrangle is land administered by the U.S. Bureau of Land Management.

Climate in the area is mostly semiarid but varies considerably with altitude.

STRATIGRAPHY

Sedimentary rocks exposed in the quadrangle total about 7,000 feet and range in age from Late Cretaceous to early Tertiary. Just northeast of the quadrangle lower Tertiary sedimentary rocks are capped by middle Tertiary volcanic rocks. About 12,000 feet of sedimentary rocks ranging in age from Cambrian to Late Cretaceous are believed to be present in the subsurface. The oldest formation penetrated by drilling in the area is the Redwall Limestone of Mississippian age. The lithology and the thickness of stratigraphic units are shown in the generalized columnar section.

The Straight Cliffs Formation (Upper Cretaceous), which contains the major coal resources of the area, was divided for mapping purposes into an upper and a lower part. The upper part is essentially equivalent to the Drip Tank and John Henry Members, and the lower part is approximately equivalent to the Smoky Hollow and Tibbet Canyon Members in the southeastern and eastern Kaiparowits Plateau.

The contact between the lower and upper parts of the Straight Cliffs Formation in the quadrangle was chosen at the top of a persistent white fine- to coarse-grained and partly conglomeratic sandstone about 400 feet above the base of the formation. The white conglomeratic sandstone is believed to be equivalent to the Calico bed (Peterson, 1969, p. J7-J9), an informal unit that was found at the top of the Smoky Hollow Member in the southeastern Kaiparowits Plateau. The Smoky Hollow Member in the eastern Kaiparowits region is overlain unconformably by the John Henry Member. The conglomeratic sandstone in the Pine Lake quadrangle was selected as a mappable horizon that is believed to be in the approximate stratigraphic position of the unconformity separating the Smoky Hollow and John Henry Members in the eastern Kaiparowits.

STRUCTURE

The major structural feature in the quadrangle is the Johns Valley anticline, a north-northwest-trending fold in the northwestern part of the area. The fold is asymmetrical with steep dips as much as 40° on the east flank and dips generally 10° or less on the west flank. The anticline plunges southward and dies out near Henderson Canyon. A homoclinal trend with dips of 7°-15° E. extends on southward from the south end of the anticline.

The Pasture Canyon syncline, a gentle northwest-trending symmetrical fold with dips of 5°-11° lies just southwest of the Johns Valley anticline. The axes of the syncline and the anticline converge and die out to the southeast near Henderson Canyon.

A northwest-trending fault about 1½ miles long that has a throw of about 80-100 feet down to the west occurs in the southwestern part of the quadrangle.

Structure contours were drawn on top of a white conglomeratic sandstone at the top of the lower part of the Straight Cliffs Formation.

ECONOMIC GEOLOGY

Coal

The major coal resources of the region are in the upper part of the Straight Cliffs Formation which is widely exposed in the western third of the quadrangle. Nearly all the mappable coal is in the lower third of the upper part of the Straight Cliffs and crops out in a belt about 4½ miles long in the southwestern part of the quadrangle. The major coal-bearing interval in the quadrangle is the Henderson coal zone, a relatively continuous coal-bearing interval containing one or more coal beds, that occurs about 100-150 feet above the base of the upper part of the Straight Cliffs. The Henderson coal zone is present at various depths in the subsurface in the northwestern part of the quadrangle and is probably present elsewhere in most of the quadrangle except in the southwest corner where it has been removed by erosion. The thickness of individual beds in the Henderson zone ranges from a few inches to 18 feet. Locally, the individual coal beds may contain thin shaly partings or they may grade laterally into carbonaceous shale or mudstone, but nearly everywhere in the outcrop area coal of minable thickness and quality is present in the Henderson zone.

Thinner and more lenticular coal beds as much as 3 feet thick occur locally in outcrops above the Henderson zone, mostly from 50 to 120 feet above the Henderson. In the southwestern part of the quadrangle the middle third of the upper part of the Straight Cliffs contains beds of highly carbonaceous shale or mudstone, but no mappable coal was observed in the carbonaceous beds. In the northwest, however, subsurface data as well as surface outcrops west of the quadrangle show the presence of some coal beds thicker than 14 inches above the Henderson zone. Cuttings from the Tenneco Johns Valley 1 well indicate that coal beds more than 4 feet thick are present approximately 500 and 680 feet above the Henderson zone. Surface outcrops in Paradise Canyon just west of the quadrangle show two coal beds 6 and 9 feet thick about 500 feet above the Henderson zone. No coal of workable thickness was found in the lower part of the Straight Cliffs, although a persistent zone of carbonaceous mudstone containing thin beds of coal ranging in thickness from a few inches to about 1 foot occurs about 120 feet above the base of the formation.

Coal mines.--Three abandoned mines, all in the Henderson zone, are in the quadrangle. Production was small, mostly for local consumption. The largest mine in the area, the Shakespeare, or Tropic, mine in the NW¼NW¼ sec. 23, T. 36 S., R. 2 W., was last operated in 1962; total production was probably about a few tens of thousands of tons (Robison, 1966, p. 41). The Davies mine in the NE¼NE¼ sec. 36, T. 36 S., R. 2 W., was operated only in the winter of 1952. A third mine, the Pollack, is reported to have been across the canyon northwest of the Davies mine (Robison, 1966, p. 41), probably in sec. 25. A coal section measured by Gregory and Moore (1931, p. 152-153) at the Pollack mine contained 22 feet of total coal, and the thickest bed measured nearly 10 feet. All the mines are presently inaccessible due to slump or caving at the portals.

Quality of coal.--In general, the Straight Cliffs coal of the Kaiparowits field 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. Three tipple samples from the Shakespeare mine collected in 1956 averaged 9,030 British thermal units on an as-received basis and contained less than 12 percent ash and 1 percent sulfur (Grose and others, 1967, p. 75). A channel sample from within the Davies mine, collected 80 feet back from the portal, had a heat value of 10,126 British thermal units on an as-received basis, an ash content of 9.5 percent, and a sulfur content of 1 percent (Robison, 1966, p. 38). Three samples of core from the Fehr No. 1 coal test hole near the California Johns Valley No. 1 well averaged about 10,050 British thermal units and contained less than 10 percent ash (Robison, p. 39).

Dakota coal.--The Dakota Formation, about 150-250 feet thick, does not crop out in the quadrangle, but it is present in the subsurface throughout the area. The Dakota contains some coal beds, interbedded with sandstone and mudstone, where it crops out south and southwest of the quadrangle. The thickest coal beds in the outcrop area are approximately 6 feet thick. In general, the Dakota coal is thin, highly lenticular, and of poorer quality than the Straight Cliffs coal. No subsurface data on the amount of coal in the Dakota in the eastern and southern parts of the quadrangle are available. Holes drilled in the northwestern part showed no significant amounts of Dakota coal.

Resources.--Inferred resources of coal in the Henderson coal zone were calculated only for the area west of the 6,000-foot structure contour. An estimated 216 million short tons of coal in beds exceeding 4 feet in thickness occurs at depths less than 2,500 feet. No subsurface data for the eastern part of the quadrangle are available, but considerable coal resources probably occur at depths ranging from about 1,500 feet in the south to more than 7,000 feet beneath the Table Cliff Plateau in the northeast.

Indicated and inferred reserves for the Tropic area were reported on a township basis for depths less than 3,000 feet by Robison (1966, p. 40) and summarized for the Pine Lake quadrangle by Doelling (1970, p. 122).

Oil and gas

Four test wells have been drilled for oil and gas on the Johns Valley anticline in the northwest quarter of the quadrangle. Good shows of oil were reported from the Shinarump, Moenkopi, Kaibab, White Rim, Toroweap, Cedar Mesa, and Redwall, but the wells were abandoned owing to economic considerations. The Johns Valley anticline lies about 12 miles west of the Upper Valley oil field, operated by Tenneco Oil Co., which has been producing since 1964.

Gravel

Gravel for road metal is currently being produced from a gravel pit in alluvium near the mouth of Henderson Canyon in sec. 27, T. 36 S., R. 2 W., and from terrace deposits along Henrieville Creek just south of the quadrangle. Some gravel has been produced from a pit in the NE¼SW¼ sec. 24, T. 35 S., R. 2 W., near Pine Lake.

Pediment deposits present locally in the quadrangle contain poorly sorted gravel of relatively poor quality. The surficial deposits at higher altitudes in the area are mostly poorly sorted to unsorted deposits composed largely of subangular to angular limestone clasts in a sandy calcareous matrix. Areas mapped as colluvium may locally contain coarse lag gravels of pebbles and cobbles derived from weathering of the Canaan Peak Formation.

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