AREAL GEOLOGY

OF THE

CAMP CROOK AND MIDLAND NO. 4 QUADRANGLES

STATE OF SOUTH DAKOTA
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STATE GEOLOGICAL SURVEY
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EXPLANATION

SEDIMENTARY ROCKS

QUATERNARY

RECENT

Qal — Alluvium
(Silt, sand, gravel and clay of recent detrital deposits along valley bottoms of modern major streams. 0'–30')

Qds — Dune Sand
(Sand, quartz, rounded; forming grassed dunes with a few "blowouts". 10'–40' relief)

PLEISTOCENE

Qtg — Terrace Deposits
(Silt, sand, gravel, clay and conglomerate of older detrital deposits in ancient valley bottoms, floodplains, channels and pediments. 10'–100')

Qtg — Terrace Gravels
(Gravel and conglomerate composed of soft White River limestone, humic material, silt, and some siliceous pebbles. 10'–25')

TERTIARY

OLIGOCENE

White River Group

Tob — Brule Formation
(Clay, pink, sandy in part, nodular, chalcedony seams, bentonitic; massive to thick bedded; weathers light gray; turtle fragments; 80')

Toc — Chadron Formation
(Sandstone, white, unconsolidated, fine grained; upper part is a maroon to purple, bentonitic, clay grading upward into "caliche" like sandy limestone beds. 60')

PALEOCENE

Tpls / Tpl — Ludlow Formation
(Sandstone, shale, and silt interbedded; calcareous; soft pastel colors of cream, yellow, and gray. Numerous lignites and peat-clays; generally unconsolidated; thin-bedded; clinkers and burned clay; fossil plants; only basal portion of Ludlow present in this quadrangle; includes the "Shadehill" Tpls facies. 0'–55')

CRETACEOUS

UPPER CRETACEOUS

(Buffalo)

Kh — Hell Creek Formation
(Upper part: Sandstone, yellow to golden brown, coarse grained, porous, flaggy, peat-clays; log like concretions. Middle part: Somber beds, shale, sand and peat-clay inter-bedded, gray to black; erodes into "mudstacks"; black iron-manganese concretions; fossil wood; dinosaur bones. Lower part: Sandstone, gray, yellow, when oxidized, coarser grained than lower Fox Hills; some peat-clays and somber beds; basal scouring channels. 260'–380')

Kf — Fox Hills Formation
(Sandstone, gray to white, fine grained, silty, quartz and some black mica; weathers pale yellow, thin-bedded; tabular cross-bedding; friable; finely laminated concretions; shark teeth and *Halymenites major*. Basal part not exposed. 15')

DRAINAGE

Intermittent Streams

CULTURE

Buildings
(House, church, and school)

Roads and Trails

x B.M. 3010
Bench Marks
(Monuments marking points of known altitude)

3080
Altitudes
(In feet above sea level.)

BRACE
Triangulation Stations
(U.S. Coast & Geodetic and/or U.S. Geological Survey monuments marking points of exact geographic location)

Operating
Abandoned
Gravel pits

x 36"
Coal Thickness
(Exposed)

2 / 36' / 2' — Top Hole Altitude / Overburden Thickness / (Coal)
Drill Holes

Hunt ○ State No. 1
Oil-test Borings

Geology by J.J. Schulte and M.F. Nielson
Assisted by R. Schoon, O. Rosenbaum, E. Glazier, R. Wilson
Surveyed in 1955 – Drafted by F.V. Steece
Coal-Test Holes Drilled in 1955-56

Base Map by South Dakota State Geological Survey

APPROXIMATE MEAN DECLINATION 1957 — TRUE NORTH / MAGNETIC NORTH 15°

Scale = 1/62500
½ 0 1 2 3 4 MILES
Vermillion South Dakota
1957

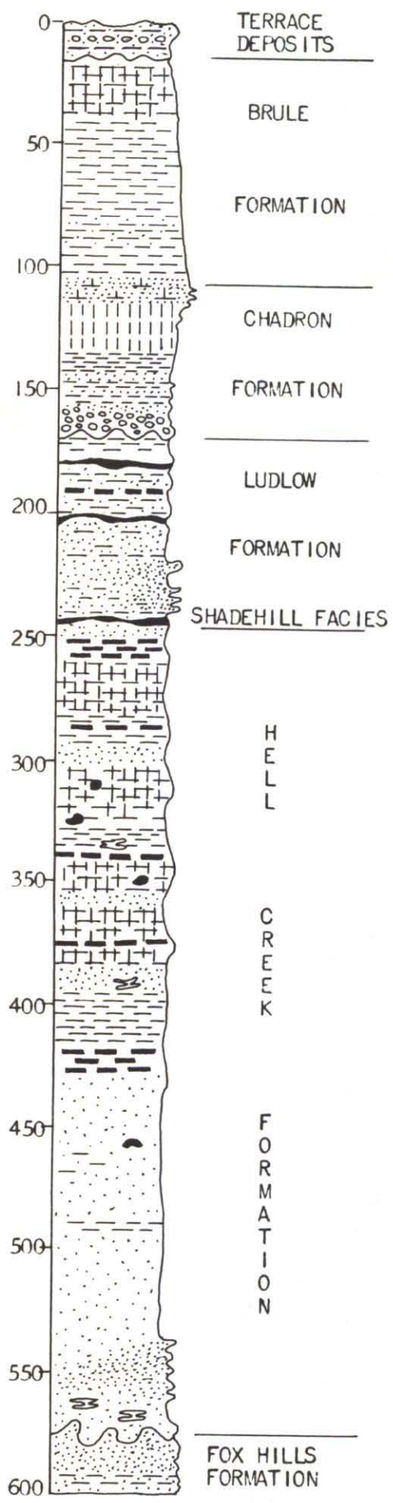
■ Quadrangle Location

AREAL GEOLOGY OF THE CAMP CROOK AND MIDLAND NO. 4 QUADRANGLES

By

J. J. Schulte

GENERALIZED COLUMNAR SECTION



INTRODUCTION

The areal geology of these quadrangles was mapped as a part of the South Dakota Geological Survey's coal resources program during July and August, 1955. Exploratory drilling for sub-surface coal was done the following year. Stratigraphy was determined by "walking out" contacts and delineating them on aerial photographs. There are about 211 square miles in the Camp Crook quadrangle and about 38 square miles in the Midland #4 quadrangle.

LOCATION

These quadrangles are located in western Harding County. The Midland #4 quadrangle borders Carter County, Montana. The center of the quadrangles is 15 air miles west of Buffalo, South Dakota, about 200 air miles northwest of Pierre, 112 air miles north-northwest of Rapid City. The Camp Crook quadrangle is bounded by parallels 45°30' and 45°45' north latitude, and meridian 103°45' and 104° west longitude. The Midland #4 quadrangle is bounded by parallels 45°30' and 45°45' north latitude, and meridians 104° and 104°02'42" west longitude.

GEOGRAPHY

The area lies in the northern Great Plains province. It is mostly rolling, grass covered prairie but "bad land" topography developes in the southeastern corner of the Camp Crook quadrangle. The Little Missouri River drains all of the quadrangles except the southeastern corner of Camp Crook quadrangle which is drained by the South Fork of the Grand River. All other streams are intermittent. Stock dams usually carry water throughout the year. Maximum elevation is 3470 feet above sea level on USGS triangulation station Brace and minimum elevation is 2992 feet above sea level along the Little Missouri River where it leaves the north part of the quadrangles.

The climate is semi-arid with an average annual rainfall of 12 inches. Ranching is the only occupation. Camp Crook is the only town with a population of 122. There are no railroads; State Highway #8 goes through the quadrangles from Buffalo to Camp Crook; other roads are secondary or county roads.

Vegetation is all prairie grasses except for short sage brush in the meander plains of the Little Missouri River.

Rock exposures are only fair and spotted through the quadrangles.

STRATIGRAPHY

Surface formations consists of sediments of upper Cretaceous, Oligocene, Miocene (or Pliocene) and Quaternary age. The Hell Creek formation of upper Cretaceous age forms the bedrock of nearly all the quadrangles. Terrace deposits are numerous and thick in the meander plain of the Little Missouri River. New evidence suggests that a pronounced erosional unconformity exists between the Hell Creek formation and the Fox Hills formation. The Fox Hills formation is mapped for the first time in these quadrangles. The only completely exposed formation is the Fox Hills; other formations are outliers or erosional remnants not representative of the complete formations.

Fox Hills Formation (Meek and Hayden 1861) (Upper Cretaceous). About 15' of the Fox Hills formation is exposed in a single locality in the Camp Crook quadrangle. The Hell Creek formation scours deeply into the Fox Hills in this location; the Fox Hills consists of gray, medium grained sandstone; composed of subangular quartz and biotite; it is silty and calcareous. Above this sandstone is an interbedded gray shale and silty sandstone which is probably Fox Hills; it has a marine type of bedding which the Hell Creek above does not have. Shark teeth were found in the river bed below the outcrops. A finely laminated reddish brown ironstone concretion (2") is characteristic of the contact between the Fox Hills formation and the Hell Creek formation.

Hell Creek Formation (Brown 1907) (Upper Cretaceous). The lower part of this formation can very readily be confused with the upper part of the Fox Hills sandstone. This is due in part to reworking of the Fox Hills sandstone in to the Hell Creek sediments. Basal Hell Creek channels scour deeply (20'-50') into the Fox Hills formation. The three parts of the Hell Creek could not be mapped because of inadequate exposures and irregularity of these three zones.

Upper part: Yellow to golden brown sandstone, coarse grained, porous, flaggy; with several peat clays; with log-like concretions; with the plant ?Halymenites major, and marcasite concretions. An upper Hell Creek lignite horizon has been mapped in the east half of the quadrangle. This zone may possibly correlate with the Shadehill facies in adjacent quadrangles.

Middle part: This part consists of the somber beds which are the interbedded dark gray shales, peat clays and lensing, impure sands. They are probably of eolian origin; the shale beds are tough or cohesive and the peat clays are so compact that they are very resistive to erosion; thus these somber beds form the mudstacks prominent in the badland areas; bentonite makes up a large part of the somber beds and causes small mud cracks when dry; dinosaur bones and fossil wood are common in this zone as well as numerous black manganese-iron concretions.

Lower part: Gray, coarse grained, porous, flaggy sandstone; yellow when weathered; frequently unconsolidated; calcareous; blocky concretions and sandstone lenses occur sparsely and irregularly; frequent dinosaur bones or fragments; occasional gray shale and peat clay. These fluvial channels cut deeply into the Fox Hills sandstone causing irregular thickness of both the Fox Hills and Hell Creek formations. Although the entire formation is exposed, it is very difficult to measure a complete section; settling, slumping and flowing hinder such measurements; the formation varies from 280' to 400' in western Harding County.

The formation forms the bedrock of nearly all the quadrangles.

Ludlow Formation (Lloyd and Hares 1915) (Paleocene). The contact between the Hell Creek and Ludlow is transitional and difficult to determine; in these quadrangles, the Shade Hill coal facies is included in the Ludlow and forms the red, burned shale buttes in the north part of the quadrangle. A coarse textured, porous, golden brown sandstone marks the top of the Hell Creek, whereas the Ludlow consists of soft pastel colored, fine textured, interbedded silt, shale and sandstone; prominent colors are cream, yellow and gray; it is generally unconsolidated and thin-bedded. Numerous lignites and peat clays lense throughout the formation and occasionally burn into red clinker.

Only the basal part of the Ludlow formation is present as outliers in these quadrangles which amounts to about 55 feet. A few feet of Ludlow may be present on the western edge of the Midland #4 quadrangle where the beds are mapped as Hell Creek.

Chadron Formation (N. H. Darton 1899) (Oligocene). One small erosional remnant is present in the Camp Crook quadrangle; it consists of white unconsolidated, fine grained sandstone; it is bentonitic and calcareous; the upper part is a maroon to purple, bentonitic, clay grading upward into "caliche" like sandy limestone beds; there is about 60 feet present. The Chadron is unconformable with the Hell Creek below and conformable with the Brule above.

Brule Formation (N. H. Darton 1898) (Oligocene). The Brule is conformable with the Chadron at the same erosional remnant as above. It consists of pink, sandy clay; it is nodular and has chalcedony seams; it is bentonitic; weathers light gray and is massive to thick-bedded; turtle fragments are common; about 80 feet is present.

Quaternary Deposits. These sediments consist of terraces of Pleistocene age, and older and younger alluvium, dune sand, and younger terraces, all of Recent age. Most prominent are Recent and Pleistocene terraces along the Little Missouri River. It is difficult to delineate between younger and older alluvium terraces in the meander plain of the Little Missouri River.

STRUCTURE

The quadrangles occupy a position on the southwestern flank of the Williston basin where the basin has been elevated by the extension of the Black Hills uplift and disturbed by folds off the Cedar Creek anticline. Regional strike is northwest-southeast and regional dip is northeast into the deeper part of the basin. Regional dip is normally about 45 feet per mile or about $\frac{1}{2}^{o}$. The Ogallala (Arikaree?) beds are flat-lying and do not reflect regional dip or plunge.

Determination of structure of surface rocks is hindered by the slumping flowing or settling of the incompetent Cretaceous sediments. For that reason, more than 50% of the dips, strikes and plunges are pseudo. The southeast trending Camp Crook anticline mapped by Moulton & Bass in 1922, roughly follows the Little Missouri river and appears to be the dominant structure in the quadrangles. A structure called the Gallup Creek dome lies in the extreme northeastern corner of the area in the headwaters of Gallup Creek.

ECONOMIC GEOLOGY

Uranium has not been discovered in commercial quantities in these quadrangles to date.

Oil and Gas in commercial quantities are possibly present in these quadrangles; it is believed that the reservoir beds, source beds and capping beds are present at depth beneath these quadrangles; favorable structure could be present on the Camp Crook anticline and Gallup Creek dome; suspected faulting is masked by overburden but could provide oil traps if they carry with depth.

Gravel and sand occur contaminated with Ogallala talus material, conglomerate and humic material in these quadrangles in high terrace channel deposits as erosional remnants.

TABLE I

Section	Twp.	Rge.	Acres	Ave. Thickness	Est. Cubic Yards
7,8,17	18 N	1 E	185	12 feet	3,381,600.00
36	19 N	1 E	6	6 feet	58,060.00
13	19 N	2 E	29	7 feet	327,506.00
16	18 N	1 E	2	10 feet	32,266.00

Coal is confined to two areas in the quadrangle. The upper area is the northeastern portion of T. 20 N., R. 2 E., where Hell Creek coals crop out in Secs. 3, 10 & 11 and Ludlow coal in Secs. 13 & 34, T. 21 N., R. 2 E. The lower area is the southwestern portion of T. 19 N., R. 3 E., where Hell Creek coals crop out in Secs. 20, 25 & 31, T. 19 N., R. 2 E. Ludlow coals crop out around two outliers in Secs. 20 & 30 in T. 19 N., R. 3 E. The upper area has a total estimated reserve of about 238,000 tons and the lower area has 153,000 tons. Neither area is an important coal reserve because the coal thicknesses range from 9 to 20 inches which is not considered commercial or workable deposits.