AREAL GEOLOGY
OF THE
SORUM QUADRANGLE

STATE OF SOUTH DAKOTA
JOE FOSS, GOVERNOR

STATE GEOLOGICAL SURVEY
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EXPLANATION

SEDIMENTARY ROCKS

QUATERNARY

RECENT

Qal — Alluvium
(Valley-bottom deposits of clay, silt, sand and gravel in Rabbit and Antelope Creeks)

PLEISTOCENE

Qaal — Older Alluvium
(Older alluvial deposits above present floodplains of Rabbit and Antelope Creeks)

Qtg — Terrace Gravel
(Terrace deposits of sand and gravel up to 28' thick. Occasionally river silt or loess covered)

TERTIARY

OLIGOCENE

Toc — Chadron Formation
(Light green, sandy, flaky clay. About 20' thick. Limited to one small exposure)

Tptb — Tongue River Boulders
(Residual deposits of gray to brown, wind polished orthoquartzite boulders derived from Tongue River Fm.)

PALEOCENE

Tpl / Tpls — Ludlow Formation
(Yellow, friable, calcareous, ledge forming sandstones, numerous coal horizons. Buff to yellow silt, darker silty clays alternate with the sandstones. Tpls - Shadehill coal facies at base of Ludlow, coal horizons grading laterally into peat clay and/or "blackjack" beds. Formation about 200' thick)

CRETACEOUS

UPPER CRETACEOUS

Kh — Hell Creek Formation
("Somber beds" of light to dark gray bentonitic clay. Gray to yellow fine sand. A coal horizon in upper part. Few calcareous-cemented sandstone ledges. Mn-Fe and limonitic concretions. About 240+' thick)

DRAINAGE
Intermittent Streams
Intermittent Lakes

CULTURE
Buildings
(House, church, and school)
Roads and Trails
x B.M. 2798 — Bench Marks
(Monuments marking points of known altitude.)
AGATE — Triangulation Stations
(U.S. Coast & Geodetic and/or U.S. Geological Survey monuments marking points of exact geographic location.)
Operating / Abandoned — Coal mines and Gravel pits
X 36" — Coal Thickness
(Exposed)
2323 Top Hole / Altitude / 36' Overburden / 2' Thickness (coal) — Drill Holes

Geology by E. J. Bolin
Assisted by E. J. Buckmeier
Surveyed in 1954
Coal-Test Holes Drilled in 1956

Base Map by South Dakota State Geological Survey

APPROXIMATE MEAN DECLINATION 1954

Scale = 1/62500
½ 0 1 2 3 4 MILES

Vermillion, South Dakota
1956

Quadrangle Location

AREAL GEOLOGY OF THE SORUM QUADRANGLE

By
Edward J. Bolin

INTRODUCTION

The quadrangle was mapped during August of 1954 as part of the State Geological Survey's coal resources program. The coal test holes were drilled in the summer of 1955.

LOCATION

The quadrangle occupies the west-central portion of Perkins County and includes a strip about 2½ miles wide in southeastern Harding County. It lies about 80 miles north-northeast of Rapid City and about 130 miles northwest of Pierre. The area includes about 210 square miles between parallels 45°15' and 45°30' north latitude and meridians 102°45' and 103°00' east longitude.

GEOGRAPHY

Rabbit and Antelope Creeks follow meandering courses slightly south of east across the quadrangle and form the major watersheds of the region. North of Rabbit Creek the surface rises rapidly for about 250 feet to the rolling meadow on the interstream divide between Rabbit Creek and the South Fork of Grand River. The Rabbit-Antelope Creek divide is sharp and rugged in the western part of the area but slopes eastward to rolling prairie lands. Antelope Creek occupies a broad valley with gentle slopes on both sides. The Antelope Creek-Moreau River divide in the southern part of the quadrangle is largely rolling, grass-covered prairie but small areas of badlands are developed along some of the creeks. The extreme southern portion of the area is drained by south flowing tributaries to the Moreau.

The total relief of the quadrangle is about 350 feet.

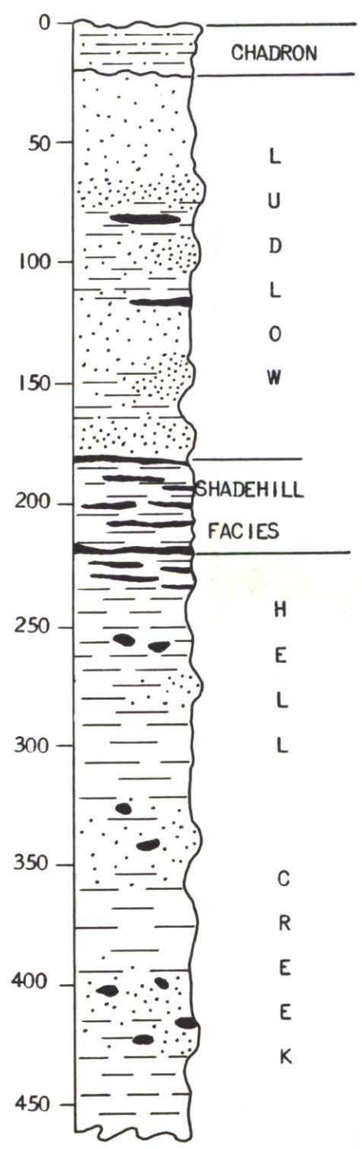
The quadrangle lies in a semi-arid region of very sparse population. The meadow lands in the northern part of the area are nearly all under cultivation, and in places the rolling prairies to the south have been cultivated. However, the soil derived from the Hell Creek in the latter area is not very fertile, and the majority of this region is used for grazing.

There are no towns in the quadrangle but there is a general store and church at Sorum in the NE¼, Sec. 7, T. 17 N., R. 10 E. There are no railroads or highways crossing the quadrangle, but much of it is made accessible by two north-south roads and shorter crossroads joining them.

STRATIGRAPHY

The exposed sediments range in age from Upper Cretaceous to Recent. The Upper Hell Creek (Upper Cretaceous age) forms the bedrock along the stream valleys and on the rolling prairies, and the Ludlow formation (Paleocene age) forms the bedrock on the higher interstream divides. A small deposit of the Chadron formation (Oligocene age) lies in Sec. 14, T. 17 N., R. 9 E., Harding County. Large areas in the valleys of Rabbit and Antelope Creeks are occupied by Pleistocene terrace gravels and Pleistocene-Recent loess and alluvium.

GENERALIZED COLUMNAR SECTION



Upper Hell Creek, Hell Creek Formation (Brown, 1907). Two hundred and forty feet, more or less, of the Upper Hell Creek is exposed in the area. It consists predominantly of light to dark gray, highly bentonitic clay, with thin beds of gray to yellow fine sand. The shales and clays are highly plastic and slippery when wet, but upon exposure and drying become hard and pustular. Concretions of limonite and manganese-iron are scattered throughout, and are abundant locally. A coal horizon in the upper part of the unit is exposed at several places north of Rabbit Creek in the northeastern part of the quadrangle. This horizon contains coal of potential economic value at places, and appears to be continuous for several miles in contrast to the extreme lenticularity of most Upper Hell Creek coals. Thin discontinuous beds of blackjack and peat clay are common in the upper part. Rapid lateral and vertical variations in color and texture are typical of the sediments.

Ludlow Formation (Lloyd and Hares, 1915). The Hell Creek-Ludlow contact is placed at the base of the lowest coal or associated lithology in the Shadehill facies of the Ludlow. Where this basal coal facies is absent the contact lies at the horizon where the prevailingly "somber" colored bentonitic sediments of the Hell Creek give way to the buff and yellow silty and sandy strata of the Ludlow. The contact is quite arbitrary in areas of gentle topography because it is obscured by soil and vegetation.

About 200 feet of the Ludlow formation is exposed on the Rabbit-Antelope Creek divide in the western part of the quadrangle. Small outliers of the formation occur on the interstream divide between Antelope Creek and the Moreau River to the south.

The Ludlow is characterized by yellow, friable, calcareous, ledge-forming sandstones, and numerous coal horizons in the area. These alternate with buff to yellow loose silt and sand, and darker silty, flaky clay. The coal horizons contain thin coal beds associated with much brown peat clay, blackjack and black carbonaceous shale. Few of the coal horizons could be traced for any appreciable distance, but the Shadehill facies at the base of the Ludlow was recognized at numerous places in the area. (Elevations should make more correlations within the area possiele, and should also facilitate some correlations with the coal facies to the east).

Tongue River Boulders, Tongue River Formation. Thick concentrations of residual orthoquartzite boulders blanket the Ludlow formation in the northeast corner of the quadrangle. The boulders are light gray and possess a high degree of wind polish (ventifacts) and vesicular impressions of roots and branches.

Chadron Formation (Darton, 1899). About 20 feet of light green, sandy, flaky clay of the Chadron formation is exposed on a small hill in Sec. 14, T. 17 N., R. 9 E. This deposit does not project above the Ludlow sands and silts on adjacent hills showing that the Chadron was laid down on a very uneven erosion surface developed on the Ludlow. Slabs of very light gray limestone and boulders of dense, light grayish brown orthoquartzite are densely scattered over the surface of this Chadron deposit. This indicates that the orthoquartzite boulders so prominent at the surface throughout much of northwestern South Dakota are derived in part from the Chadron formation as well as from the Tongue River formation.

STRUCTURE

The quadrangle lies on the west flank of the Dakota (Williston) Basin. The surface strata have a gentle northeast dip in the western part of the area and a more nearly north dip to the east. These dips are less than 40 feet per mile. Small faults with displacements of less than 10 feet are found at places, and minor flexures are undoubtedly superimposed on the regional structure of the area.

ECONOMICS

No mineral products are being exploited from the area at the present time, but there are vast reserves of gravel and bentonitic clay, and lesser reserves of coal in the quadrangle.

COAL

A coal horizon near the top of the Upper Hell Creek is exposed at several places on the north side of Rabbit Creek in the eastern part of the area. This coal was formerly mined at the Knudsen Mine in the NE¼, Sec. 2, T. 17 N., R. 10 E., altitude 2777 and the Phillips Mine in the SW¼, Sec. 7, T. 17 N., R. 11 E., altitude 2690. The coal attains a maximum thickness of 43 inches to the east of the Phillips Mine in Sec. 17, T. 17 N., R. 11 E. This horizon is much more persistent than most of the coal facies in the Upper Hell Creek. Total reserves of potentially commercial coal from this horizon are estimated to be 1,632,700 tons, (the Knudsen Mine may be in the Shadehill).

The Shadehill facies at the base of the Ludlow formation is not as persistent in this area as it is to the north, and does not contain any coal of potential commercial value.

A coal bed exposed in the SW¼, Sec. 9, T. 17 N., R. 11 E., attains a maximum thickness of 40 inches. It contains estimated reserves of 686,800 tons of coal, but if mined on a large scale would have to go underground.

Approximately 40 feet above the above mentioned coal another coal horizon is exposed on several sandstone capped hills in Secs. 7, 8 and 16 of the same township. This horizon has a total thickness of more than 30 feet on a steep sided hill in the NE¼, SW¼, Sec. 7, where it includes four coal beds. The lowest of these is 54 inches thick and is the most persistent in the area. It is doubtful if commercial development of this horizon would be possible because of the limited areas underlain by the coal.

Ludlow coals crop out at several horizons on the Rabbit-Antelope Creek divide in the western and central parts of the quadrangle. In the SW¼, Sec. 27, T. 17 N., R. 10 E., a bed 42 inches thick was mined on a small scale for local use in the early 1900's. The overburden here is thin and the coal is badly weathered. In the eastern part of Sec. 30 two coals separated by 2½ feet of clay are found at about this same horizon. The lower of these is 30 inches thick but is probably limited in extent. In this region there is an estimated reserve of 992,000 tons of coal.

The chemical character of the lignite is shown in the table.

Table PROXIMATE ANALYSIS

COAL	SEC	TPS	RGE	MOISTURE	VOLATILE	CARBON	ASH	SULFUR	B.T.U.
Hillen	27	17	10	45.26%	31.51%	16.37%	6.86%	0.92%	4688
Hell Creek	7	17	11	41.17	31.24	20.66	6.93	0.58	5126

Analyses by the State Chemical Laboratory, Vermillion, South Dakota

GRAVEL

Large gravel terraces occur on both sides of Rabbit Creek, and smaller ones are found on the south side of Antelope Creek. These terraces have a thin veneer of silt, and the gravels are poorly sorted and stratified. Most of the terraces contain less than five feet of gravel, but 13 feet is exposed in an abandoned pit at Sorum and two and one-half miles west on this same terrace it is seven feet thick at another abandoned pit. The gravel attains a maximum thickness of 28 feet on the nose of a terrace in the SW¼, Sec. 17, T. 17 N., R. 11 E., but it thins rapidly to 2½ feet on the main part of this terrace.

Ten terraces along Rabbit Creek contain an estimated 19,700,000 cubic yards of gravel, and the terraces on the south side of Antelope Creek contain an estimated 2,081,200 cubic yards.

CLAY

The Upper Hell Creek contains vast amounts of highly bentonitic clay which makes excellent impervious material for the construction and repair of stock dams.