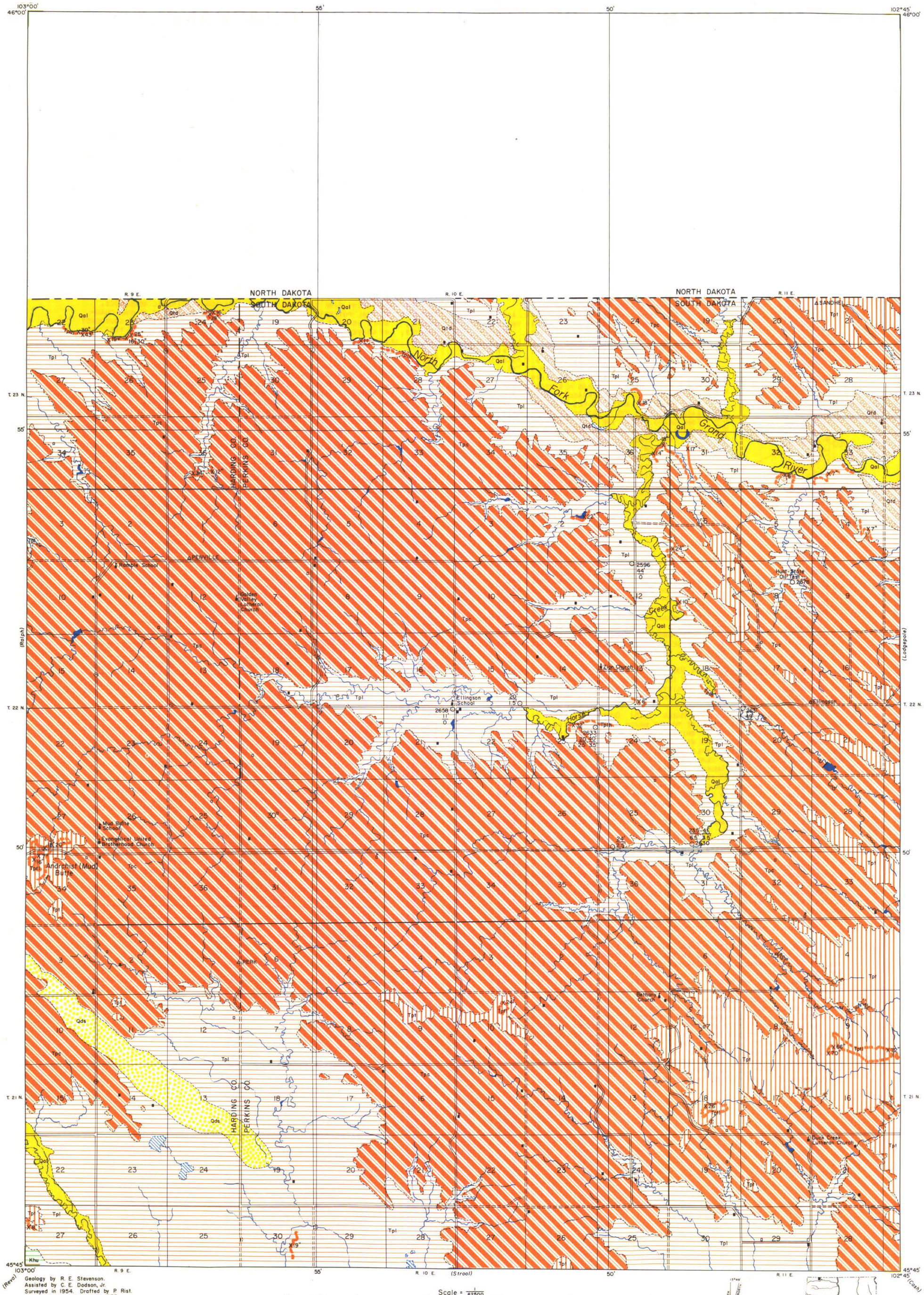
AREAL GEOLOGY

OF THE

ELLINGSON QUADRANGLE

STATE OF SOUTH DAKOTA
JOE FOSS, GOVERNOR

STATE GEOLOGICAL SURVEY
E. P. ROTHROCK, STATE GEOLOGIST



EXPLANATION

SEDIMENTARY ROCKS

QUATERNARY

RECENT

Qal — Alluvium
(Floodplain deposits of silt, sand, and gravel in major stream valleys.)

Dune Sand
(Sand, quartz, clear with some darker mineral grains, forms grassed dunes.)

PLEISTOCENE

Qtd — Terrace Deposits
(Terrace deposits of fluvial silt, sand, and gravel along the North Fork of the Grand River.)

TERTIARY

PALEOCENE

Tpl — Tongue River Formation
(Yellow to buff, fine to medium-grained, semi-consolidated crossbedded, subgraywacke sand with abundant irregular calcareous cementations, and white to buff siltstone. Interbeds of gray clay and silty clay. Tpll–Lodgepole facies: 1 or 2 seams, 7" to 72" thick, of black blocky lignite and associated buff sands, gray clays, brown to black peat-clays, and a thin bed of light gray siliceous clay-silt ("orthoquartzite").

Tpc — Cannonball Formation
(Gray to tan silt and silty fine subgraywacke sand with abundant dark gray dense limestone concretions. Local light gray calcareous fine-grained sandstone ledges. Marine invertebrate fossils. Interfingers with the upper Ludlow.)

Tpln / Tpl — Ludlow Formation
(Light gray to buff, fine to medium-grained, subgraywacke sand with local irregular calcareous cementations. Local white calcareous sandstone ledge. Interbeds of gray to buff silt and silty clay. Numerous cross-bedding and oscillation ripples. Tpln–Hillen facies: 1 or more seams, 7" to 78" thick, of black, blocky, or fissile lignite and associated beds of gray to buff clay. Tpls Shadehill gray bentonitic clay and brown peat clay.)

CRETACEOUS

UPPER CRETACEOUS

Khu — Upper Member
(Dull gray and brown bentonitic clays and silts.)
Hell Creek Formation

DRAINAGE

Intermittent Streams

Lakes

CULTURE

Buildings
(House, church, and school)

Roads and Trails

x B.M. 2800
Bench Marks
(Monuments marking points of known altitude.)

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

Operating
Abandoned
Lignite mines

x 36"
Lignite Thickness
(Exposed)

2850 Top Hole
0 Altitude
48.5 Overburden
5.5 Thickness
Drill Holes

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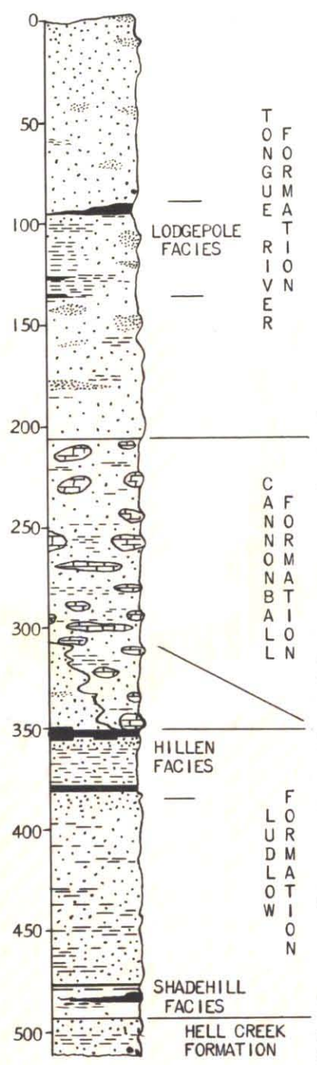
By
Robert E. Stevenson

GENERALIZED COLUMNAR SECTION



INTRODUCTION

The quadrangle was mapped geologically in the summer of 1954 as a part of the State Geological Survey's coal resources program. Exploratory drilling for lignite was done the following year.

LOCATION

The Ellingson quadrangle lies in the northwest corner of Perkins County and the northeast corner of Harding County, along the North Dakota line. The area is approximately 160 miles northwest of Pierre and 120 miles north of Rapid City.

GEOGRAPHY

Rolling prairie land with a few scattered buttes and small mesas are the diagnostic topographic features of this region. A prominent high point is Anarchist (Mud) Butte on the western border of the quadrangle.

Sandstone capped buttes and mesas are present in the eastern quarter and in the south central part of the mapped area. Most of the rest of the quadrangle is a rolling plateau with low relief, cut only by the wide gentle valley of Horse Creek. This plateau-like area is bordered on the north by the valley of the North Fork Grand River. The North Fork Grand River has a narrow floodplain and two well defined terraces about 15 and 25 feet above the water level. (The upper terrace mapped as Qtd). Aside from the North Fork Grand River, the only permanent water bodies are the numerous stock reservoirs.

The principal agricultural pursuits are dryland farming and stock grazing, for the climate is semi-arid with an average rainfall of 13-15 inches. The region is sparsely inhabited with a population index of 2 families per 5 square miles, and it has no settlements. Along the west side of the quadrangle, in Harding County, is State Highway 75, a north-south graveled road. The rest of the area is fairly accessible by good county and township roads.

STRATIGRAPHY

Surface formations range in age from late Cretaceous to Recent. The only completely exposed formations are the Cannonball and Ludlow of Paleocene age. Contacts between the pre-Pleistocene formations--Hell Creek, Ludlow, Cannonball and Tongue River are conformable; the Pleistocene sediments, however, lie on the older rocks with a marked unconformity. With the exception of the marine Cannonball, all the rocks were deposited under terrestrial conditions.

Hell Creek Formation Brown 1907 Upper Member: Hell Creek outcrops are restricted to an area of about 100 acres in the southwestern corner of the quadrangle. The formation consists of a series of dull grey and brown bentonitic clays and silts, and is approximately 15 feet thick.

Ludlow Formation Lloyd and Hares 1915: Outcrops of this formation are limited to the areas adjacent to the major drainage areas. The formation is dominantly a buff to white, fine to medium, cross-bedded, sub-graywacke to subquartzose sand with occasional lensing and interbedded calcareous, cross-bedded, ripple marked, sandstone ledges and cementations; and locally laminated grey clay and silty clay.

Near the top of the Ludlow in this region is the Hillen lignitic facies which consists of about 35 feet of lensing and interbedded grey silty clay, fine white sand, brown peat-clay and two major seams of black, blocky to fissile lignite, the upper ranging from 6 inches to 78 inches in thickness and the lower from 6 inches to 43 inches in thickness.

About 95 feet below the Hillen at the base of the formation is the Shadehill facies--approximately 15 feet of grey silty clay, grey bentonitic clay, and brown peat-clay.

There is 140 to 185 feet of Ludlow exposed in this quadrangle. The uppermost strata interfingers with the Cannonball formation.

Cannonball Formation Lloyd 1914: Fragments of the characteristic rounded concretions of this formation are scattered over the rolling grasslands of the mapped area. These small to medium, light to dark grey, dense to fine-grained limestone concretions are imbedded in a buff to light grey clayey laminated sand, silty sand, and silty or sandy clay. There are occasional calcareous sandstone cementations and ledges. The limy rocks carry a marine fauna of small pelecypods and gastropods.

The formation varies in thickness from 110 to 150 feet in thickness.

Tongue River Formation (Taff 1909): The sandstone ledges of this formation are found in the uplands in the eastern quarter and south-central part of the quadrangle, and on Anarchist (Mud) Butte along the west edge of the mapped area.

The sediments are mostly yellow to buff, medium to fine, lensing and cross-bedded subgraywacke with numerous calcareous cementations and ledges. There are many interbeds of buff clayey laminated sandy and clayey silt, horizons of limonitic concretions and horizons rich in plant fragments. About 200 feet of this formation is present in the mapped area.

About 110 to 70 feet above the base of the formation is the Lodgepole lignitic facies. It consists of a fairly continuous upper seam of black, blocky, hard lignite, ranging from 72 inches in the east to 7 inches in the west. The more local lower seams are both less than 2 feet thick and more fissile than the upper. Interbedded with the lignites are brown peat-clays, brown to grey clays, silty clays, and slightly bentonitic clay. The facies varies from 10 to 50 feet in thickness.

Terrace Deposits: Along the North Fork Grand River is a terrace capped by up to 5 feet of interlensing rounded to subangular silt, sand, and gravel dominantly of local origin, but with some foreign material.

Recent Deposits: In the southwestern quarter of the mapped area is an elongate northwest-southeast area of grassed-over sand dunes. In this half a mile wide and 4 mile long strip, the dunes are less than 15 feet in height and usually small. The sand is typical dune sand, rounded and somewhat frosted.

Mapped as alluvium and alluvial deposits are the recent accumulations of silt, sand, and gravel in the valleys of the major waterways in the quadrangle. Most of the material is floodplain deposits, but includes some low terraces along some tributary streams.

STRUCTURE

A slight northeastward regional dip (7 feet per mile) toward the center of the Dakota (Williston) Basin is diagnostic of this area. There are a number of small secondary folds and faults whose amplitudes and displacements are usually less than 20 feet.

ECONOMIC GEOLOGY

At the present time there is no exploitation of mineral resources. There are several potentially commercial deposits of lignite in the quadrangle, a small deposit of uraniferous lignite (ore grade) in the southeast quarter, and gravel deposits along the North Fork Grand River. A test well for oil has been drilled in this area (northwest quarter).

Coal: There are two lignite horizons in this area, the Hillen facies of the Ludlow formation, and the Lodgepole facies of the Tongue River formation, both of which carry minable seams.

Hillen Lignite: This lignite was first mined in the early 1900's and again in the 1930's. There are two minable seams, the upper varying from 6 to 78 inches in thickness and the lower from 6 to 43 inches. The lignite is black in color, brownish-black in streak, brittle, blocky to fissile, banded; minor quantities of jarosite, melanterite, selenite, and marcasite are present. The lignite slacks upon drying (increasing the B.t.u. content) and is non-coking. A proximate analysis is shown in Table 1.

The largest possible commercial Hillen lignite deposit lies just south of the Zion Church in the center of the quadrangle. The estimated[1/] tonnage is 13,000,000 short tons. A small deposit containing a possible 1,300,000 short tons is present in the northwest corner of the mapped area and another of 250,000 short tons in the southwest corner.

1/ About 40% of this deposit's tonnage estimate is measured (located within a half mile or less from a measured thickness), the rest is termed indicated (in this case less than a mile from a measured thickness).

Lodgepole Lignite: This lignite was mined a little in the 1930's. There is one minable seam, 7 to 72 inches in thickness. The lignite is black in color, brownish-black in streak, brittle, blocky or fissile; like the Hillen lignite, it contains minor amounts of jarosite, melanterite, selenite and marcasite. It is non-coking and slacks upon drying. The chemical character of the lignite is shown in Table 1.

The only minable Lodgepole lignite is located in two areas in the vicinity of Duck Creek Lutheran Church in the southeast part of the quadrangle. The tonnage estimates are 800,000 short tons measured.

Table 1 PROXIMATE ANALYSES

Coal	Location Sec Tsp Rge	Moisture	Volatile Matter	Fixed Carbon	Sulfur	Ash	B.t.u.
Lodgepole[2/]	9 21N 11E	37.43	42.14	7.62	0.25	12.81	5,060
Hillen[2/]	34 22N 11E	37.87	39.95	13.57	0.27	8.61	5,252
Hillen[3/]	24 23N 9E	41.70	30.00	9.00	2.6	19.30	3,260

Table 2 ULTIMATE ANALYSES

Coal	Location Sec Tsp Rge	Hydrogen	Carbon	Nitrogen	Oxygen	Sulfur	Ash
Hillen[3/]	24 23N 9E	5.8	23.0	0.5	48.8	2.6	19.3

2/ Analyses by State Chemical Laboratory, Vermillion, S.D.
3/ Analyses by U. S. Bureau of Mines, Pittsburgh, Penna.

Sand and Gravel: Sand and gravel bars in the North Fork Grand River and some of the adjacent terrace deposits could be utilized for road surfacing; if washed and sized, they would be suitable for some concrete aggregates.

Oil and Gas: There are no visible surface structures in which oil and gas might accumulate, but buried structures as well as sedimentary traps may exist. The best possibilities for oil production are in the Mission Canyon formation (at depths of about 6900 feet) which is productive to the north in North Dakota. The Hunt-U.S.A. No. 1 (northwest quarter) drilled in 1954 to the Cambrian ? at a depth of 9,433 feet, was a dry hole.

Uranium: The deposit of Lodgepole lignite lying to the northeast of Duck Creek Lutheran Church has been analyzed by the Federal Government[4/] for uranium. The average analysis is 0.01% uranium in the upper 3 feet of the lignite seam, resulting in an estimated resource of 46 short tons of uranium in the estimated lignite reserve.

4/ Densen, 1952

REFERENCES CITED

Densen, N. M., 1952; Summary of Uranium-bearing Coal, Lignite, and Carbonaceous Shale Investigations in the Rocky Mountain Region During 1951; U. S. Geol. Survey, Trace Elements Memo. 341A, 43pp.