AREAL GEOLOGY

OF THE

MOUTH OF BULL CREEK QUADRANGLE

STATE OF SOUTH DAKOTA
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STATE GEOLOGICAL SURVEY
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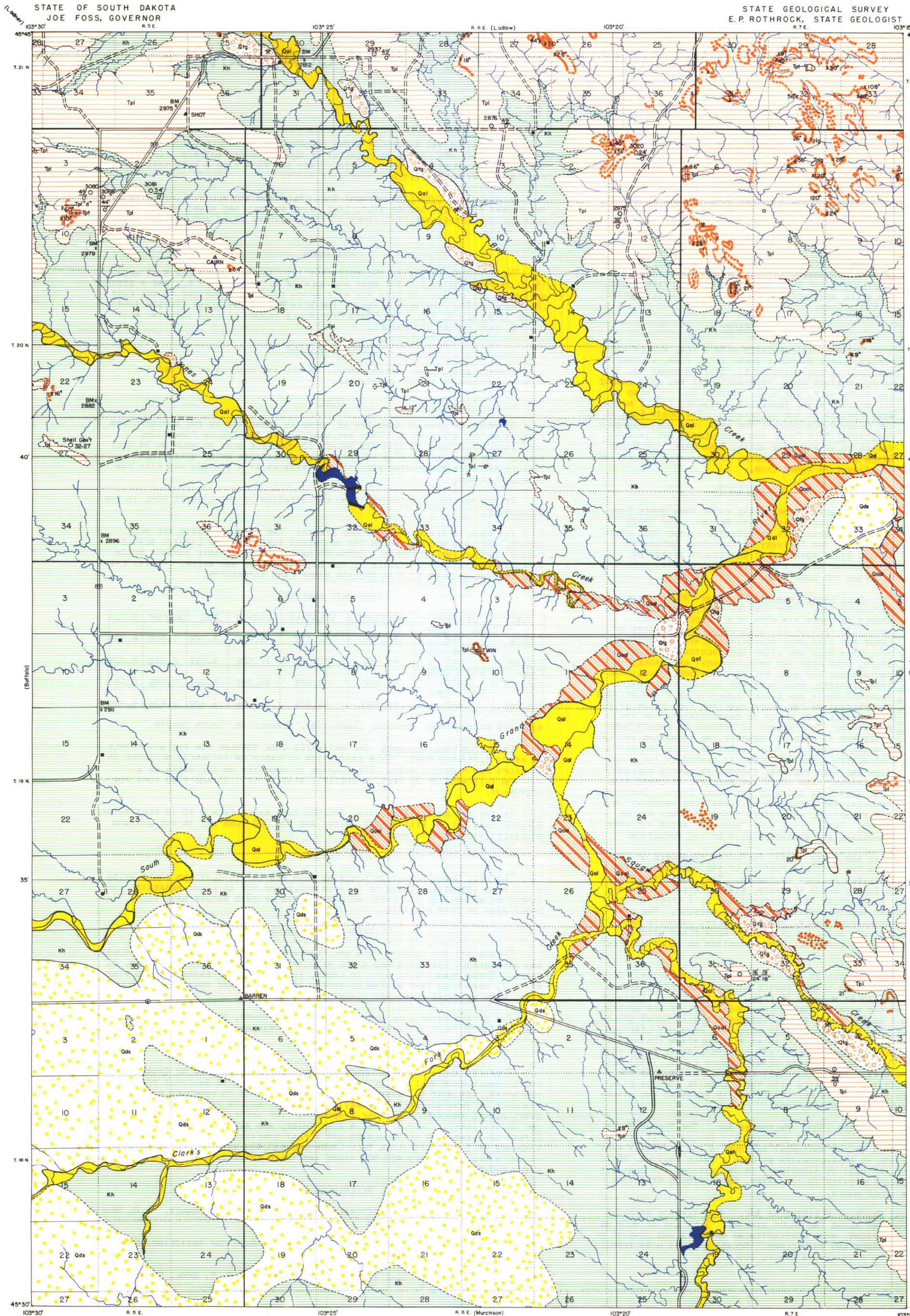

EXPLANATION

SEDIMENTARY ROCKS

QUATERNARY

RECENT

Qal — Alluvium
(Floodplain or valley bottom deposits clay, silt and sand in present streams)

Qds — Dune Sand
(Sand, quartz, clear with some darker mineral grains, forms grassed dunes and drifting dunes)

PLEISTOCENE

Qoal — Older Alluvium
(Older valley bottom deposits above present streams)

Qtg — Terrace Gravel
(Terrace deposits of sand and gravel)

TERTIARY

PALEOCENE

Tpl — Tongue River Formation
(Sandstone, light yellowish-brown to brown, occasional purplish and greenish hues are common. Massive, cross-bedded, loosely consolidated to indurated, carbonaceous fragments, petrified wood, silty sands and quartzitic sands. 0-150' in thickness, Buffalo Quadrangle)

Tplg / Tpl / Tpls — Ludlow Formation
(Buff to yellowish fine sands and silts, calcareous sands are ledgemakers, numerous lignite beds from a few inches to 14 feet thick, brown peat clay, peat, black carbonaceous shale, gypsum, jarosite and/or melanterite are associated with lignite. Rusty ironstone concretions at random. The uppermost thick coal is locally called the Giannonatti bed, Tplg- 8 to 14' thick, possibly the same as "D" new designation bed in the South Cave Hills. Tpls- Shadehill facies at base of the formation. Thickness about 250')

CRETACEOUS

UPPER CRETACEOUS

Kh — Hell Creek Formation
("Somber Beds", gray and dark gray bentonitic clay or mudstone and shale, brown peat shale, greenish gray unconsolidated sandstone, log like sandstone cementations, abundant iron-manganese, black and rusty brown concretions, occasional lignite and carbonaceous shale. Large sandstone lenses form sand dunes. Broken dinosaur bones are numerous in "Badland" areas. About 130 feet are exposed)

Clinker and/or burned clay

DRAINAGE

Intermittent Streams

Intermittent Lakes

CULTURE

Buildings
(House, church, and school)

Roads and Trails

x B.M. 1706
Bench Marks
(Monuments marking points of known altitude.)

SHOT
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 Thickness
2' (Coal)
Drill Holes

Shell Gov't 32-27
Oil-test Boring

Geology by B.C. Petsch
Assisted by W.L. Foley and J.K. Baird
Surveyed in 1956, Drafted by F.V. Steece
Coal-Test Holes Drilled in 1956

Base Map by South Dakota State Geological Survey

APPROXIMATE MEAN DECLINATION 1956
14°11' TRUE NORTH MAGNETIC NORTH

Scale = 1/62500
½ 0 1 2 3 4 MILES

Vermillion, South Dakota
1956

■ Quadrangle Location

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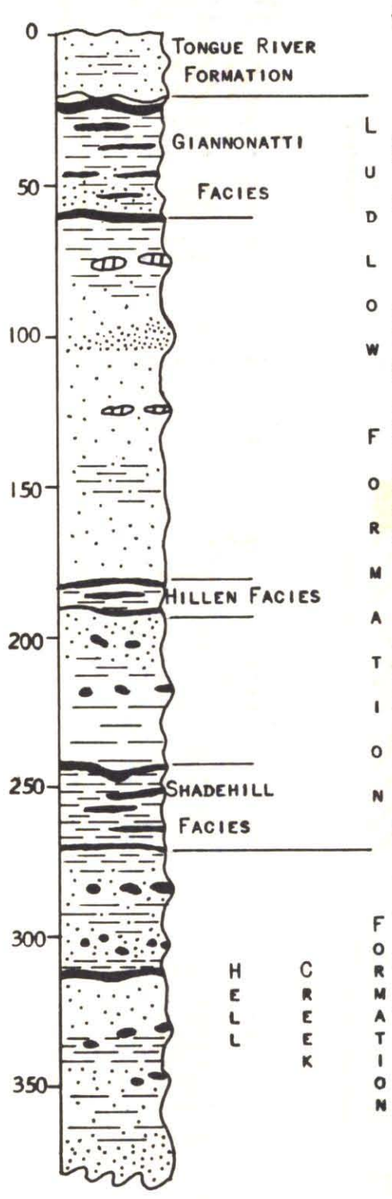
By
Bruno C. Petsch

GENERALIZED COLUMNAR SECTION



INTRODUCTION

The quadrangle was mapped in the summers of 1955 and 1956 as part of the State Geological Survey's coal resources program. Exploratory drilling for subsurface coal was done in 1956 by Robert Martin and Jon Larson. The writer was assisted by William Foley in 1955 and James K. Baird in 1956.

LOCATION

The quadrangle is in the west-central portion of Harding County. It lies between the town of Buffalo and the Slim Buttes. The area lies about 165 miles northwest of Pierre and 105 miles north of Rapid City.

GEOGRAPHY

The area is populated with a few, widely dispersed, large ranches; there is no town, village or railroad in the quadrangle. State Highway No. 8, an all weather road, traverses east and west across the south half, and U. S. Highway No. 85, also an all weather road, traverses northward in the northwest portion of the quadrangle. The South Fork of the Grand River crosses the area in a northeasterly direction; Bull Creek and Jones Creek are tributaries to it from the north; Sand Creek and Squaw Creek enter from the south. Practically the entire quadrangle is range land.

STRATIGRAPHY

The surface formations range from Upper Cretaceous through Tertiary to Recent. The Upper Cretaceous system is represented by the Hell Creek formation; the Tertiary by Paleocene Ludlow and Tongue River formations; Quaternary system by Pleistocene gravels and terrace deposits, Recent alluvium and dune sand.

Hell Creek Formation (Brown 1907) Upper Cretaceous Age. The greater portion of the quadrangle is underlain with Hell Creek bedrock. About 130 feet of it is exposed. It consists of light and dark gray bentonitic clays or mudstone, yellowish gray and light gray bentonitic clays and silts, dark gray and greenish-gray graywacke, uncemented, but well packed sandstone, occasional thin lignites, peat clay and carbonaceous shale. Abundant rusty and black iron-manganese concretions are present in the upper part and they break up to fine gravel size which is characteristic of the formation. This gravel is present on smooth surfaces and is used to identify the formation in flat lowland pastures. Huge lenses of yellowish-gray uncemented sandstone occur at random in the formation and when they are exposed in gently rolling topography, sand dunes are present. A large sand dune area lies south of the Grand River. Sandstone cementations appearing as "logs" are abundant in the formation, and broken dinosaur bones can be found. Small, five acre "badland" areas and bare mud buttes which dot the landscape are characteristic of the formation.

Ludlow Formation (Lloyd and Hares 1915) Paleocene exposures of the Ludlow formation are found in the northern portion of the quadrangle, and on the higher interstream divides farther southward. They consist of tan, buff, and yellow silts and sands, which are hard, stand vertical, but are uncemented. Occasionally a sandstone is calcareous and is a ledge-maker. Fissile to massive clays and some laminated shales are present. The lignite facies have black carbonaceous shale, jet black clay, jarosite and gypsum with brown clays and peat clays which contain much plant material, such as leaves, decayed wood and charcoal. The formation is about 250 feet thick.

The Ludlow is easily recognized by its abundant lignitic facies. There can be as many as ei ht seams in a single facies outcrop and they range in thickness from a few inches to as much as 14 feet. The lowermost facies is the Shadehill which is at the base of the Ludlow formation. It has several thin lignite seams from 2 to 30 inches thick, interbedded with brown shales, black carbonaceous shale, and rusty brown peat which has abundant leaf and stem material. A good example of Shadehill is at triangulation station Twin. The Hillen facies is in about middle Ludlow, it contains lignite seams from 20 to 60 inches thick. The B and C lignite seams (Denson et al, 1955) correlate with the Hillen facies. The Giannonatti facies is at or near the top of the Ludlow and possibly correlates with the D lignite (Denson et al, 1955). This coal ranges from 5 to 14 feet thick and is found at the higher altitudes in the northern portion of the area.

Tongue River Formation (Taff 1909) Paleocene Age. The Tongue River formation is not well represented in this quadrangle. Traces of it are confined to two small buttes in the northwest and one in the northeast part of the area. The formation is characterized by only a small portion, 10 to 20 feet, of the lower of two massive sandstones in the region. It consists of light tan to brown unconsolidated to indurated, cross-bedded sandstone and is a small cliff or ledge-maker.

Terrace Deposits and Gravels Pleistocene Age. High terrace deposits or older alluvium are present along the major streams. They lie as much as 20 feet above the valley bottoms, make perpendicular outcrops and consist of light-gray, bedded silts, sands and thin clays. Occasionally a high terrace has a rounded shoulder which signifies a gravel cover.

The gravels are generally brown colored due to broken concretionary material. They are coarse and consist of concretionary material, chert, and sandstone chunks of local origin. They are from 1 to 6 feet thick and are covered by a few feet of loess-like soils.

Alluvium and Dune Sand Recent Age. Alluvium and alluvial deposits are the recent accumulations of silt, sand, some gravel, and gumbo in the meander areas of the larger valleys. They support abundant grass and contain many water holes.

STRUCTURE

The regional dip is to the northeast into the Williston Basin at about 15 to 25 feet per mile. The west one-half of T. 19 N., R. 7 E., has a strong northwest dip of over 50 feet per mile which suggests structure to the east (Rothrock 1937). The west flank of the Slim Buttes anticline (Petsch 1954) is in T. 20 N., R. 7 E. The South Cave Hills trough extends into the west-central part of the quadrangle.

ECONOMIC GEOLOGY

Lignite coal, clay, pseudoscoria, gravel and shallow water are the economic resources in the quadrangle.

COAL

Outcrops of lignite coal can be found in abundance in the northeastern portion of the quadrangle. They are confined to the Ludlow formation; individual beds range from a few inches to workable beds as much as 14 feet thick. The thick deposit is in the higher elevations which makes them ideally situated for mining because stripping is at a minimum and pits can be well drained.

At the present time there is no exploitation of the lignite coal in the quadrangle.

The coal is black in color and streak. The thick deposits are well bedded, hard and blocky behind the weathered surface. The lignite slacks easily several inches inward. Outcrops have a sooty or soil surface which supports vegetation as readily as the material above and below. Hence, lignite tracing is difficult in rolling range land topography.

PROXIMATE ANALYSES

COAL	LOCATION	MOISTURE	VOLATILE	CARBON	ASH	SULFUR	B.T.U
Ludlow	Sec 1 T20N R6E	35.70%	42.17%	6.41%	15.72%	1.90%	6,398
Hillen	Sec 36 T21N R6E	35.55%	37.08%	17.52%	9.85%	0.33%	8,279
Giannonatti	Sec 5 T20N R7E	42.81%	40.84%	10.29%	6.06%	0.49%	8,563
'D" Bed	Sec 4 T20N R5E	31.58%	41.87%	11.22%	15.33%	2.43%	6,988

Analyses by the State Chemical Laboratory, Vermillion, South Dakota

Estimated Coal Reserves The estimated coal tonnage for the quadrangle is about 1,342,000 tons. This estimation is based on thickness measured on outcrops and prospect pits. The tonnage is computed on the basis of a minimum thickness of 2½ feet, a specific gravity of 1.25 and 1700 tons per acre-foot.

In the thickness categories, 340,000 tons range from 8 to 14 feet thick; 501,000 tons are in beds 5 feet thick; and 500,000 tons are in the minimum workable thickness of about 3 feet.

CLAY

The Hell Creek formation contains much bentonitic clay and shale which might be a potential source of bloated shale for use as light aggregate for cementing materials. To date, no experiments of this nature have been undertaken on this material.

CLINKER AND BURNED CLAY

Throughout the lignite area are places where the lignite has been burned and as a result the clays and sands associated with it are fused, baked, or fired. These places give rise to large, thick masses of bright red to pink, brittle, hard rock that resembles broken brick; some are huge clinker boulders. Many of these burns are quarried.

The broken brick-like material is used on roads, driveways and ranch yards. The clinker boulders are used for rip-rap on stock dams.

GRAVEL

Terraces along Bull and Jones Creeks and the South Fork of Grand River occasionally have huge gravel deposits. The material is suitable for road surfacing, but must be washed for concrete work. It is composed of broken limonite or iron-manganese concretions, quartz, broken petrified wood, quartzite, flint, and hard sandstone fragments. The deposits range in size from one to ten acres. They average 4 feet thick, and are found under at least 2 feet of overburden which always has a flat surface. Estimated cubic yardages in 5 deposits along Bull Creek are 653,400 yards. Four deposits on the river will yield 459,800 yards and three deposits on Squaw Creek will yield 677,600 yards.

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