SOUTH DAKOTA GEOLOGICAL SURVEY

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GEOLOGY
of the
KEYAPAHA QUADRANGLE
SOUTH DAKOTA

EXPLANATION

QUATERNARY

RECENT

Qal — Alluvium

(Deposits of silt, sand, and gravel in present stream valleys)

PLEISTOCENE

Qt — Terrace Deposits

(Fluvial deposits of silt, sand, and gravel above present streams)

TERTIARY

PLIOCENE

Tpa — Ash Hollow Formation

(Light-gray to white calcareous silty sandstone. Local volcanic ash. Fossil hackberry seeds. Maximum thickness 41 feet.)

Tb — Bijou Facies

(Green fine-grained quartzose sandstone in Valentine Formation, one to three feet thick.)

Tpv — Valentine Formation

(Light-green clayey loosely consolidated calcareous sandstone; vertebrate fossils; maximum thickness 112 feet. Brown hydrosilicate facies;--hard brown hydrosilicate ("burnt rock"); as much as three feet thick. Limestone facies;--pinkish-gray fossiliferous limestone; as much as two feet thick.)

UNCONFORMITY

OLIGOCENE

Tow — White River Group

(Brule Formation,--greenish-gray to pinkish-gray silicified clayey siltstone. Chadron Formation,--pink to gray calcareous clayey siltstone. Maximum thickness 130 feet.)

UNCONFORMITY

UPPER CRETACEOUS

Kpu — Pierre Formation; Upper Unit

(Light-gray to black bentonitic non-calcareous shale. Local white to light-gray limestone concretions. As much as 20 feet thick.)

CRETACEOUS

Contact
(dashed where approximately located)

Gravel Pit

x BM 2368
Bench Mark
(monument showing exact altitude above sea level)

Keya
Triangulation Station
(monument marking exact geographic location)

House, school, and church

Cemetery

Geology by R A Schoon and W.D. Sevon, 1957

Vertical and horizontal control surveyed from triangulation and level lines of Federal surveys

Drafted by W. D. Sevon, 1957

APPROXIMATE MEAN DECLINATION 1950

Scale 1:62 500

Miles

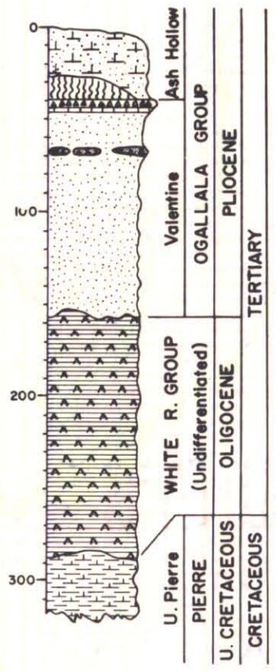
Vermillion, South Dakota
1958

Tertiary Sediments

Quadrangle Location

KEYAPAHA QUADRANGLE

Columnar Section of Exposed Rocks



Key to Columnar Section

- Calcareous Sandstone
- Volcanic Ash
- Hydrosilicate
- Limestone
- Sand
- Bijou Facies "Quartzite"
- Siliceous Clay
- Calcareous Shale

INTRODUCTION

The mapping of the Keyapaha quadrangle was completed during the summer of 1957 as a part of the State Geological Survey's geologic mapping program emphasizing economic resources. The work was under the supervision of Dr. Allen F. Agnew, State Geologist, and Dr. Robert E. Stevenson, project geologist.

The Keyapaha quadrangle includes about 218 square miles in the south-central part of South Dakota. The South Dakota-Nebraska boundary approximates with the southern border of the quadrangle.

This quadrangle includes sparsely populated prairie land and sandstone-capped buttes, and is in the Great Plains physiographic province. Two subdivisions of this province are present in the quadrangle, the Missouri Plateau and the High Plains. The contact between the White River Group and the Ogallala Group marks the boundary between these two sub-provinces.

The area is bounded on the north and south by sandstone-capped buttes. The rolling hills of the intermediate area are poorly dissected by minor streams which flow into the Keyapaha River. Local relief ranges up to 140 feet, and the maximum relief is approximately 410 feet.

The main stream, the Keyapaha River, flows southeastward across the center of the quadrangle, with the primary tributaries Sand Creek, Shady Creek, and Willow Creek. All permanent water bodies are artificially dammed.

The climate is semi-arid, characterized by a wide temperature range, an average annual rainfall of 18 inches, and by strong winds.

Two settlements, Clearfield (pop. 19) and Keyapaha (pop. 15), are the largest concentrations of population of the area.

Although the region has no hard-surfaced roads, it is served by a well developed network of unsurfaced roads and trails, which owing to the sandy nature of the soil, are passable except in times of extreme rain or snowfall.

SURFICIAL DEPOSITS

A portion of the central part of the quadrangle is covered with unconsolidated deposits which are separated into three main groups: (1) alluvium in present stream valleys, (2)terrace deposits adjacent to these valleys, and (3) wind-blown dune sand at the terrace level.

EXPOSED ROCKS

Outcropping sediments range in age from Late Cretaceous to Recent. More than 50 percent of the mapped area is covered by Pliocene Valentine fluvatile and lacustrine sediments. The buttes at the northern and southern borders of the area are capped by the more resistant Pliocene Ash Hollow sands and silts, and drainage channels commonly expose the Oligocene White River clays and silts. Although the entire area is underlain by the Cretaceous Pierre shale, only two minor exposures of the shale occur; these along the Keyapaha River in the eastern part of the area.

Cretaceous System

Pierre Formation. (Meek & Hayden, 1862)

The Pierre shale, named for exposures near Fort Pierre (80 miles north of the quadrangle), crops out in only two localities in the quadrangle, both along the Keyapaha River near the eastern boundary. Insufficient outcrops prevent correlation of the shale with either the members of Searight (1937) or the units of Agnew (1957); however, stratigraphic position indicates that the shale corresponds to the upper Pierre unit of Agnew. The western exposure (NE¼ sec. 35, T. 96 N., R. 78 W.) is black non-calcareous blocky bentonitic shale which weathers to fine light-gray flakes. The shale contains several thin light-gray limestone concretions at irregular intervals one to four feet apart. Only nine feet of this unfossiliferous shale is exposed. The eastern exposure (NE¼ sec. 36, T. 96 N., R. 78 W.) is bluish-gray non-calcareous silty limonite-stained blocky shale which weathers light-gray. Two thin layers of hard white limestone which weather light-brown are separated by eight and one-half feet of shale. There are 20 feet of shale exposed at this locality. The shale is apparently unfossiliferous. Although these shale outcrops are only one mile apart and at approximately the same altitudes, their lithologic dissimilarity suggests that they represent either two different members of the Pierre Formation, an extreme facies change, or a sharp change in geologic structure.

Tertiary System

Oligocene Series. White River Group. Meek & Hayden, 1858

The White River Group, exposed along the drainage channels throughout the quadrangle, is composed of the Chadron (lower) and the Brule Formations. These formations are not mapped as separate units in this area, but are mapped as the White River Group undifferentiated (Tow). The base of the White River Group is not exposed any where within the quadrangle, although the Chadron basal conglomerate of poorly cemented rounded quartz and chert pebbles can be found about six miles northeast of the quadrangle. Although the lack of good exposures within the quadrangle prevents positive subdivision of the White River Group into lithologic units, two lithologies do occur. The lower unit is mainly pinkish to grayish calcareous clayey siltstone which weathers white, and on fresh fractures displays a waxey luster. This siltstone contains sparse fine sub-rounded quartz grains and in some outcrops along the Keyapaha River alternates with thin layers of bentonitic clay. Upon weathering, this poorly cemented siltstone forms gentle slopes with local small ledges. The upper unit consists of greenish-gray and pinkish-gray silicified clayey siltstone containing local coarse quartz grains and pea-size clay pellets in zones. This silicified zone is rather massive on fresh outcrop, and weathers to a light-greenish or pinkish-buff rubble. This siltstone caps some hills in the southwest part of the quadrangle and forms ledges along Sand Creek. The White River Group in this area is at least 130 feet thick, but the thickness may vary considerably throughout the quadrangle. These strata appear to be unfossiliferous.

Pliocene Series. Ogallala Group. Darton, 1889

The Ogallala Group, named for exposures near Ogallala, Nebraska (about 130 miles southwest of the quadrangle) is represented in the Keyapaha quadrangle by the Valentine and Ash Hollow Formations.

Valentine Formation Barbour and Cook, 1917.--The Valentine Formation, named for exposures near Valentine, Nebraska (about 20 miles southwest of the quadrangle), is mainly a very light-green clayey unconsolidated to poorly consolidated calcareous sandstone. This sandstone is composed of relatively well sorted sub-rounded fine to medium quartz grains. The upper 15 feet of this formation is an olive-green silicified clayey siltstone with a semi-waxey luster on fresh fractures. The upper one-foot of the unit contains small irregular shaped calcareous white concretionary nodules. The conformable contact with the overlying Ash Hollow Formation is at the base of the lowest cemented sand of the Ash Hollow Formation, and is easily recognized. Owing to the rapid weathering of the unconsolidated sands, fresh exposures are uncommon, and most of the Valentine Formation appears as reworked slopewash sand and sand dunes. This formation has a maximum thickness of 112 feet in the quadrangle. Fossils are rather scarce, but vertebrate fossils are present.

Three distinct local Valentine facies are present in the Keyapaha quadrangle; the Bijou "quartzite", a brown hydrosilicate, and a limestone.

Bijou facies (Stevenson, 1958).--The Bijou "quartzite" is a hard green silica-cemented fine-grained quartzose sandstone. This "quartzite" caps buttes and occurs at various levels throughout the Valentine Formation; at one locality (NW¼SW¼ sec. 4, T. 95 N., R. 78 W.) it lies directly on the green silicified pea-ball zone of the White River Group. It varies from one to three feet thick in the quadrangle.

Brown hydrosilicate facies.--A hard brown hydrosilicate ("burnt rock") containing many cavities and fractures with filled or coated opal is present at three localities within the quadrangle. Two of the localities (NE¼ sec. 15, T. 96 N., R. 78 W., and SW¼ sec. 28, T. 95 N., R. 79 W.) expose only erosional remnants of this material, but the other locality (NW¼ sec. 12, T. 97 N., R. 78 W.) exposes a butte cap of a few acres of hydrosilicate which averages three feet thick.

Limestone facies.--Underlying the brown hydrosilicate (sec. 12, T. 97 N., R. 78 W.), is a hard pinkish-gray partly silicified dendritic fossiliferous limestone which is at least two feet thick.

Ash Hollow Formation Englemann, 1876.--The Ash Hollow Formation, named for exposures in Ash Hollow Canyon, Nebraska, 150 miles to the southwest, is light-gray to white calcareous cemented silty sandstone composed of poorly sorted subrounded quartz grains. This sandstone caps the high buttes and forms prominent ledges with marked re-entrants below. At some localities (as Clearfield triangulation station), the base is marked by stream gravels and crossbedding. The weathered surface is normally irregular and white in color, but lichens generally give it a light- to dark-gray appearance when viewed from a distance. The Ash Hollow Formation, where weathered, is characterized by a boxwork structure that resembles small rootlets. In the southern quarter of the quadrangle the Ash Hollow does not form prominent ledges, but is covered with a loose, non-resistant sand. A small volcanic ash layer is present in sec. 35, T. 95 N., R. 79 W.

The Ash Hollow Formation attains a thickness of 41 feet in the Keyapaha quadrangle.

Fossil hackberry seeds are common in the Ash Hollow, but vertebrate fossils are not.

Stream Deposits

Alluvium consists of quartz silt and sand which is derived from bedrock. It is confined to the present stream valleys and is of local origin. Terrace deposits consist of quartz silts, sands, and coarser material derived mainly from the Ash Hollow Formation and the Bijou quartzitic facies. The most extensive of these deposits are on the south side of the Keyapaha River, and represent deposits made by that stream during its lateral migration northward. The scattered terrace deposits north of the Keyapaha River represent material deposited at the point of confluence of the Keyapaha and its tributaries. These deposits range in thickness from two to six feet. Some minor terraces are present along tributary valleys.

Wind Deposits

Fine to medium dune sand is present in the central part of the quadrangle between the Keyapaha River and Sand Creek. This dune sand is derived mainly from the Valentine and Ash Hollow Formations.

SUBSURFACE ROCKS

Formations not exposed at the surface in the Keyapaha quadrangle, but probably present therein because they were penetrated in test wells drilled in and near the quadrangle limits are tabulated below:

TABLE 1.--Summary Log of Tests near Keyapaha Quadrangle

Formation	General Crude #1 Assman sec. 22, T. 98 N., R. 78 W. Tripp County (5 miles north of Keyapaha quadrangle)	General Crude #1 Vogt sec. 25, T. 99 N., R. 79 W. Tripp County (10 miles north of Keyapaha quadrangle)
	Thickness, feet	Thickness, feet
Pierre--shale	1125	945
Niobrara--chalk	170	180
Carlile--shale	250	270
Greenhorn--limestone	45	60
Belle Fourche-Mowry--shale	140	135
Newcastle--sandstone	125	155
Skull Creek--shale	90	100
"Dakota"--sandstone	680	645
Morrison (?)--shale	125	120
Sundance (?)--sandstone	80	90
Minnelusa (?)--sandstone	185	185
Precambrian--granite	-	-

STRUCTURE

The Keyapaha quadrangle lies near the southeastern margin of the Dakota (Williston) Basin. It is possible that this quadrangle lies over a Precambrian saddle which separates that basin from the Kennedy Basin or Central Nebraska Basin. Until additional data are available, the subsurface rocks of the Keyapaha quadrangle are mapped as relatively horizontal.

ECONOMIC GEOLOGY

Ground water is available in all parts of the quadrangle. Adequate resources of sand and gravel are present in the terrace deposits, abundant sand in the Valentine Formation, and limited crushed rock from the Bijou. A small amount of volcanic ash is available near the Nebraska line. Other potentially economic products are oil and gas.

Ground Water

Ground water in sufficient amount for domestic or farm use is available throughout the quadrangle. Water of excellent quality is obtained from shallow wells that penetrate the Valentine to the top of the White River Formation. Analysis by Dr. Oscar Olson, Head, Station Biochemistry, South Dakota Agricultural Experiment Station, State College, Brookings, South Dakota, reveals this water (Lyons farm, center sec. 36, T. 96 N., R. 79 W.) to contain, in parts per million: Fe 0.0, Mg 12, Na 12, K 13, Ca 40, SO_4 15, Cl 5, NO_3 1. Total dissolved solids 239. Hardness as $CaCO_3$ 126. Springs along the Valentine-White River contact are common. Good quality water can also be obtained from alluvium and terrace deposits. Few wells in this area obtain water from the Pierre shale, and this water is poor in quality.

Sand and Gravel

Sand and gravel suitable for road metal is available in the terrace deposits (approximately 13,300,000 cu. yd.) along the Keyapaha River. These gravels contain a high percentage of carbonate and argillaceous material, but have been used successfully as road metal in the past. A limited amount (about 240,000 cu. yd.) of good road metal or concrete aggregate may be obtained by crushing Bijou quartzite.

Volcanic Ash

A small amount of volcanic ash lies along the Nebraska line in sec. 35, T. 95 N., R. 79 W. Volcanic ash is used commerically as a fine abrasive.

Oil and Gas

There are no visible surface structures favorable for the accumulation of oil or gas; however, buried structures and sedimentary traps may exist within the Keyapaha quadrangle. Possible oil horizons in the quadrangle which bear investigation are; (1) the eastward thinning Minnelusa Formation which produces oil in eastern Wyoming and the southern Black Hills, and (2) stratigraphic traps in tongues of the Newcastle sandstone. There may also be gas possibilities in the Niobrara Formation.

REFERENCES

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