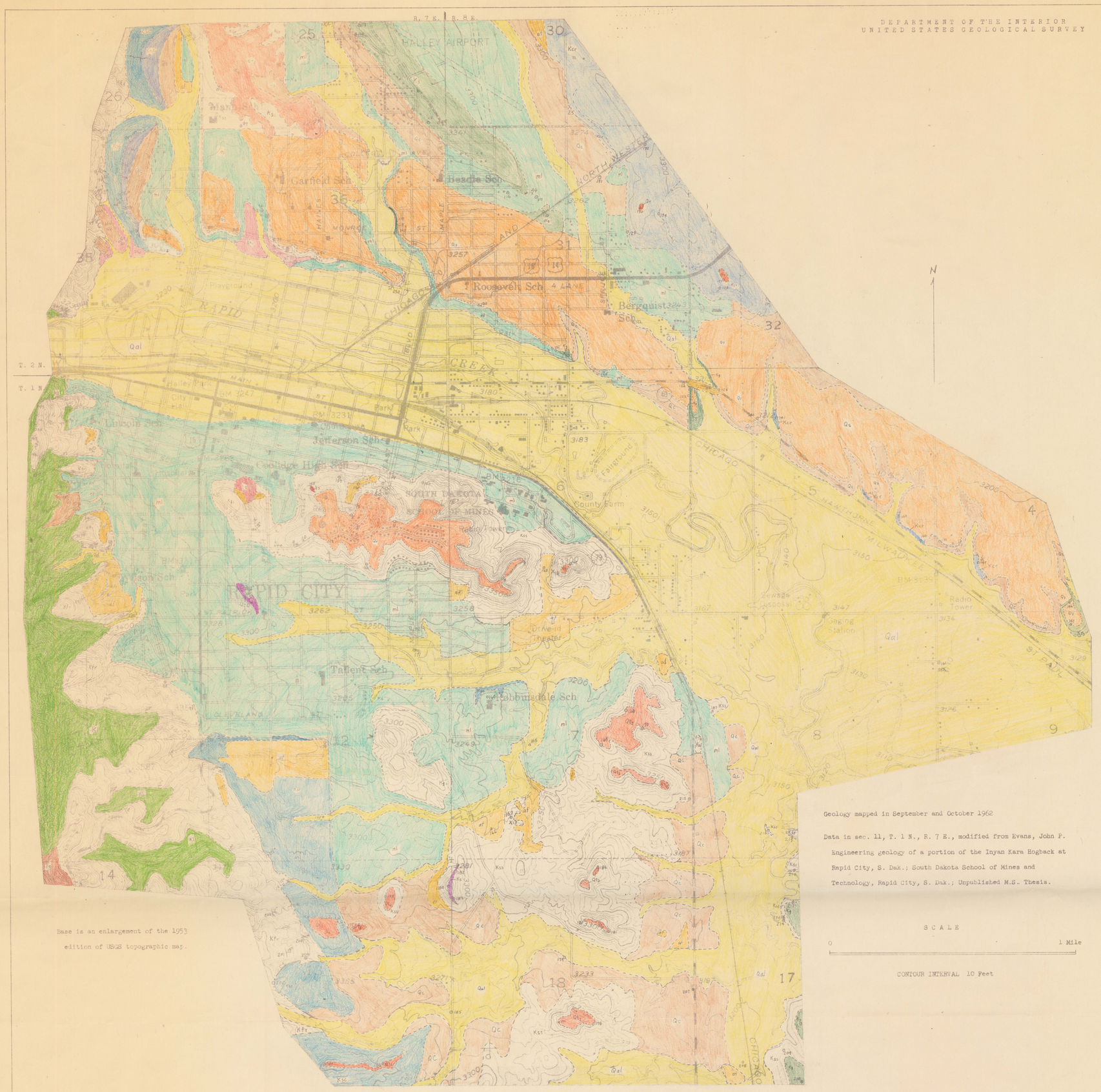
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY



Base is an enlargement of the 1953 edition of USGS topographic map.

Geology mapped in September and October 1962

Data in sec. 11, T. 1 N., R. 7 E., modified from Evans, John P. Engineering geology of a portion of the Inyan Kara Hogback at Rapid City, S. Dak.; South Dakota School of Mines and Technology, Rapid City, S. Dak.; Unpublished M.S. Thesis.

SCALE
0 — 1 Mile

CONTOUR INTERVAL 10 Feet

PRELIMINARY GEOLOGIC MAP OF PART OF THE RAPID CITY EAST QUADRANGLE, SOUTH DAKOTA

by
Ernest Dobrovolny

EXPLANATION

af — Artificial fill
Silt, clay, sand and gravel from excavation sites; locally contains construction rubble such as broken concrete slabs, bricks, tile and rubbish; in places merges with modified cut-and-fill land; artificial fill along railroads and highways not delineated in all places

ml — Modified land
Land modified by cut-and-fill on gentle to steep slopes in residential areas where embankment and shallow excavation in bedrock and colluvium is extensively concealed by vegetation, streets and buildings

ls — Landslide
Generally unstratified mixtures of shale, sand, silt, clay, and artificial fill that have moved downward and outward on steep to gentle slopes; delineated only where movement occurred recently

Qc — Colluvium
Slope and sheet wash consisting mainly of weathered shale, sand, silt, clay, sandstone fragments and small amounts of sand and gravel derived from topographically higher terrace deposits and locally some artificial fill; occurs on moderate to steep slopes; soil-forming processes are active particularly on the lower parts of sloping surfaces where the material merges with alluvium; in most places the boundary between colluvium and alluvium is gradational

Qal — Alluvium
Sand, gravel, silt, clay and artificial fill occupying the flood plain of Rapid Creek and its tributaries. In the flood plain of Rapid Creek the coarser gravel and sand of undetermined thickness is generally overlain by about 4 feet of silt, fine sand and clay; sand and gravel consist of rounded fragments of metamorphic rocks, quartzite, quartz, limestone, sandstone and chert derived from the central Black Hills region. Alluvium in the tributaries contains much locally derived bedrock material and some sand and gravel of central Black Hills origin incorporated in the alluvium by reworking of topographically higher terrace gravel deposits; in places, alluvium is indistinguishable from colluvium

Qt1 — Terrace deposits
Stratified boulders, gravel, sand and silt 10 to 20 feet above the flood plain of Rapid Creek. Consists of rounded fragments of metamorphic rocks, quartzite, quartz, limestone, sandstone and chert of central Black Hills origin in the exposure south of Garfield School in sec. 36 and mainly silt and sand of local origin in sec. 35; correlation of these two deposits is uncertain

Qs — Sturgis terrace deposits
Stratified boulders, gravel, sand, silt and some clay as much as 15 feet thick underlying a terrace surface along the north side of Rapid Creek about 60 feet above drainage. Composed of rounded fragments of metamorphic rocks, quartzite, quartz, limestone, sandstone and chert of central Black Hills origin. A thin soil overlies the gravel along the front (streamward side) of the terrace surface where the material is well exposed in many places. The deposits extend under colluvium along the back side of the terraces

Qt2 — Terrace deposits
Stratified boulders, gravel, sand and silt occurring as unnamed terrace deposits that fall between the Sturgis terrace deposits and the Rapid terrace deposits; as much as 10 feet thick

Qr — Rapid terrace deposits
Stratified boulders, gravel, sand, silt and some clay about 15 feet thick underlying a terrace surface in the central part of Rapid City south of Rapid Creek and about 180 feet above drainage: composed of rounded fragments of metamorphic rocks, quartzite, quartz, limestone, sandstone and chert. A very sandy soil about 1 foot thick overlies the deposit

Tg — Terrace deposits
Stratified boulders, gravel, sand, silt and some clay consisting of rounded fragments of metamorphic rocks, quartzite, quartz, limestone, sandstone and chert; these deposits are generally above an altitude of 3,750 feet; mapped as part of the White River Group by Darton (1925) and overlie the Mountain Meadow surface of Fillman (1929)

Kn — Niobrara Formation
Impure chalky limestone and calcareous shale; gray at depth, but deeply weathered and on most exposures is light yellow to orange; about 200 feet thick

Kc — Carlile Shale
Gray to light-gray shale with several zones of ovate limestone concretions as large as 10 feet in diameter (c) and with some sandy layers in middle and upper part; about 500 feet thick

Kg — Greenhorn Formation
Impure, slabby, buff-weathering, fossiliferous limestone in the upper part and gray to dark-gray and buff calcareous shale in lower part; highly fossiliferous light-gray limestone beds 0.1 to about 1.5 feet thick at the base; several thin bentonite beds in upper and lower part; total thickness about 350 feet

Kss / Kns / Kss — Shale and sandstone
Kss, mainly dark-gray to black expansive shale, with some lenticular light-gray to buff-weathering sandstone beds, very light-gray to light-yellow bentonite beds 0.1 to 4.0 feet thick, and scattered ferruginous and calcareous concretions; marine invertebrate fossils present in upper part; about 1,000 feet thick; unit is equivalent to Graneros Shale as mapped by Darton (1925).
Ks, lenticular beds of light-gray, medium-to fine-grained sandstone thought to occupy a position higher in the section than the Newcastle Sandstone, range in thickness from 0 to 20 feet.
Knc, Newcastle Sandstone, light-gray, buff-weathering, medium- to fine-grained sandstone, containing mainly quartz and locally some carbonized plant fragments; 0 to 60 feet thick; distinguished only in secs. 26 and 35, T. 2 N., R. 7 E.
Ksc, Skull Creek Shale, dark-gray to black expansive shale with many ironstone concretions; about 270 feet thick, recognized along the contact with the Fall River Formation in the western part of the area; upper boundary distinguished only in northwestern part of area in secs. 26 and 35, T. 2 N., R. 7 E., where Newcastle Sandstone is present

Kfr — Fall River Formation and claystone
Sandstone, siltstone and some shale about 125 feet thick; sandstone occurs as channel deposits consisting mainly of gray to buff and light-yellow rounded fragments of fine- to coarse-grained quartz; locally conglomeratic and crossbedded; ledge- and cliff-forming in places; individual beds range from 0.5 to 40 feet thick; siltstone light gray to buff with shaly partings; claystone contains carbonized plant fragments, and thin irregular ironstone layers; shale is gray to dark gray, silty, platy and weathers brownish gray

Kl — Lakota Formation
Claystone, siltstone and sandstone about 200 feet thick; claystone light gray to greenish gray, mottled pink and purple in places from weathering of ferruginous spherulites; siltstone, clayey, gray to light greenish gray, purplish gray to rusty red in places where contained ferruginous spherulites are weathered; silty sandstone, weathers light pinkish brown, locally ledge-forming, fine grained to very fine grained, locally crossbedded

Contact — Dashed where approximately located or inferred; queried where location of contact highly questionable

Fault — U, upthrown side; D, downthrown side

18/40 — Strike and dip of beds and field note station

©171 — Field note station

×5 — Approximate location of test sample data in attached table

Spring

Gravel pit

Pleistocene and Recent — QUATERNARY
Oligocene — White River Group — TERTIARY
Upper Cretaceous — Colorado Group — CRETACEOUS
Lower Cretaceous — Inyan Kara Group — CRETACEOUS

TEST DATA

Field sample number 1/	Location	Formation	Swell index (in pounds per square foot)	General category	Swelling capacity, in milliliters, of 2 g. of bentonite	Atterberg limits: Liquid limit	Atterberg limits: Plastic limit	Atterberg limits: Plastic index	pH*	Clay minerals: Total clay minerals	Clay minerals: Calcium montmorillonite	Clay minerals: Mixed layer montmorillonite	Clay minerals: Mica	Clay minerals: Kaolin	Clay minerals: Illite	Clay minerals: Chlorite	Other minerals: Quartz	Other minerals: Feldspars	Other minerals: Jarosite	Other minerals: Gypsum	Other minerals: Hematite	Other minerals: Siderite and dunite	Other minerals: Amorphous
1	NE 1/4 sec. 35, T. 2 N., R. 7 E.	Ksc	5,000	Very critical-----	----------	64	32	32	4.88	--------	--------	--------	----	------	------	--------	--------	---------	---------	------	---------	---------	---------
2	SW 1/4 sec. 12, T. 1 N., R. 7 E.	Ksc 3/	4,900	----do----------	----------	55	17	38	5.60	--------	--------	--------	----	------	------	--------	--------	---------	---------	------	---------	---------	---------
3	----do----------	Ksc	5,400	----do----------	----------	45	26	19	5.61	9/20	X	--------	----	X	X	--------	3/20	< 1/20	--------	------	---------	---------	7/20
5	NW 1/4 sec. 1, T. 1 N., R. 7 E.	Ksc 4/	9,200	----do----------	----------	51	39	12	4.00	13/20	X	--------	----	X	X	--------	5/20	< 1/20	--------	------	---------	---------	---------
5A	----do----------	Ksc 4/	11,800	----do----------	----------	48	37	11	3.80	13/20	X	--------	----	X	X	--------	6/20	1/20	--------	------	---------	---------	---------
6	SW 1/4 sec. 1, T. 1 N., R. 7 E.	Ksc 4/	12,000	----do----------	----------	48	35	13	3.98	12/20	X	--------	----	X	X	--------	5/20	1/20	1/20	------	---------	---------	---------
6A	----do----------	Ksc 4/	11,200	----do----------	----------	44	35	9	3.55	--------	--------	--------	----	------	------	--------	--------	---------	---------	------	---------	---------	---------
6B	----do----------	Ksc 3/4/	----------	----------	6.0	104	56	48	4.19	18/20	X	X	----	------	------	--------	1/20	1/20	--------	------	---------	---------	---------
9	----do----------	Ksc 3/	16,800	Very critical-----	----------	52	35	17	3.75	--------	--------	--------	----	------	------	--------	--------	---------	---------	------	---------	---------	---------
9A	----do----------	Kss	12,200	----do----------	----------	43	31	12	4.00	12/20	X	--------	----	X	X	--------	6/20	1/20	1/20	------	---------	---------	---------
9B	----do----------	Kss	12,000	----do----------	----------	43	31	12	4.14	--------	--------	--------	----	------	------	--------	--------	---------	---------	------	---------	---------	---------
10	----do----------	Kss 5/	----------	----------	8.5	165	51	114	7.58	18/20	X	--------	X	------	------	--------	1/20	1/20	--------	------	---------	---------	---------
10A	----do----------	Kss 5/	----------	----------	7.0	------	-------	-------	----	19/20	X	--------	----	X	------	--------	1/20	---------	---------	------	---------	---------	---------
13	SW 1/4 sec. 7, T. 1 N., R. 8 E.	Kss 2/	----------	----------	6.5	117	38	79	3.79	19/20	X	--------	----	------	------	--------	< 1/20	---------	---------	------	---------	---------	---------
15	NE 1/4 sec. 1, T. 1 N., R. 7 E.	Kss	11,100	Very critical-----	----------	51	34	16	3.80	--------	--------	--------	----	------	------	--------	--------	---------	---------	------	---------	---------	---------
16A	SE 1/4 sec. 1, T. 1 N., R. 7 E.	Kss	4,900	----do----------	----------	71	33	38	3.85	13/20	X	--------	----	X	X	--------	4/20	1/20	2/20	------	Trace	---------	---------
16B	----do----------	Kss	16,000	----do----------	----------	83	43	40	3.63	--------	--------	--------	----	------	------	--------	--------	---------	---------	------	---------	---------	---------
18	SW 1/4 sec. 6, T. 1 N., R. 8 E.	Kss	5,300	----do----------	----------	48	30	18	4.87	10/20	X	--------	----	X	X	X	6/20	---------	---------	------	1/20	1/20	---------
29A	NW 1/4 sec. 17, T. 1 N., R. 8 E.	Kss	2,300	Marginal----------	----------	49	34	15	7.64	5/20	X	--------	----	X	X	--------	2/20	< 1/20	2/20	10/20	---------	---------	---------
22	SE 1/4 sec. 36, T. 2 N., R. 7 E.	Kg	2,200	----do----------	----------	59	24	35	7.59	--------	--------	--------	----	------	------	--------	--------	---------	---------	------	---------	---------	---------
23	SW 1/4 sec. 31, T. 2 N., R. 8 E.	Kg	1,700	Noncritical-marginal	----------	55	27	28	7.52	--------	--------	--------	----	------	------	--------	--------	---------	---------	------	---------	---------	---------
25	SE 1/4 sec. 30, T. 2 N., R. 8 E.	Kc	1,200	Noncritical--------	----------	31	20	11	6.97	--------	--------	--------	----	------	------	--------	--------	---------	---------	------	---------	---------	---------
26	NE 1/4 sec. 9, T. 1 N., R. 8 E.	Kn	1,000	----do----------	----------	51	21	30	7.30	--------	--------	--------	----	------	------	--------	--------	---------	---------	------	---------	---------	---------
44	NW 1/4 sec. 31, T. 2 N., R. 8 E.	Qc	1,600	----do----------	----------	40	24	16	7.30	--------	--------	--------	----	------	------	--------	--------	---------	---------	------	---------	---------	---------
38	NW 1/4 sec. 9, T. 1 N., R. 8 E.	Qal	1,600	----do----------	----------	35	20	15	7.80	--------	--------	--------	----	------	------	--------	--------	---------	---------	------	---------	---------	---------
43	SE 1/4 sec. 25, T. 2 N., R. 7 E.	Qal	1,000	----do----------	----------	54	18	36	7.61	--------	--------	--------	----	------	------	--------	--------	---------	---------	------	---------	---------	---------

1/ Letter following number denotes more than one sample taken from locality.

2/ Samples of disaggregated air-dried material were tested with a proving ring device (soil potential volume change meter) developed under auspices of the Federal Housing Administration; data are referenced to methods described in Lambe (1960).

3/ Sample is weathered and frost heaved.

4/ Sample from a stratigraphic position within the Mowry Shale as used by many authors in nearby areas.

5/ Sample of bentonite.

6/ Sample from a stratigraphic position of the lower part of the Belle Fourche Shale as used by many authors in nearby areas.

* Analyses by Thomas C. Nichols, Jr. and Robert A. Speirer Engineering Geology Branch Laboratory. Results given in parts per 20 parts; X indicates mineral greater than 1/20 of sample.

Prepared by Ernest Dobrovolny, February 1963
Rapid City Project, South Dakota

References cited

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