Geologic Map of the Tilford Quadrangle, South Dakota

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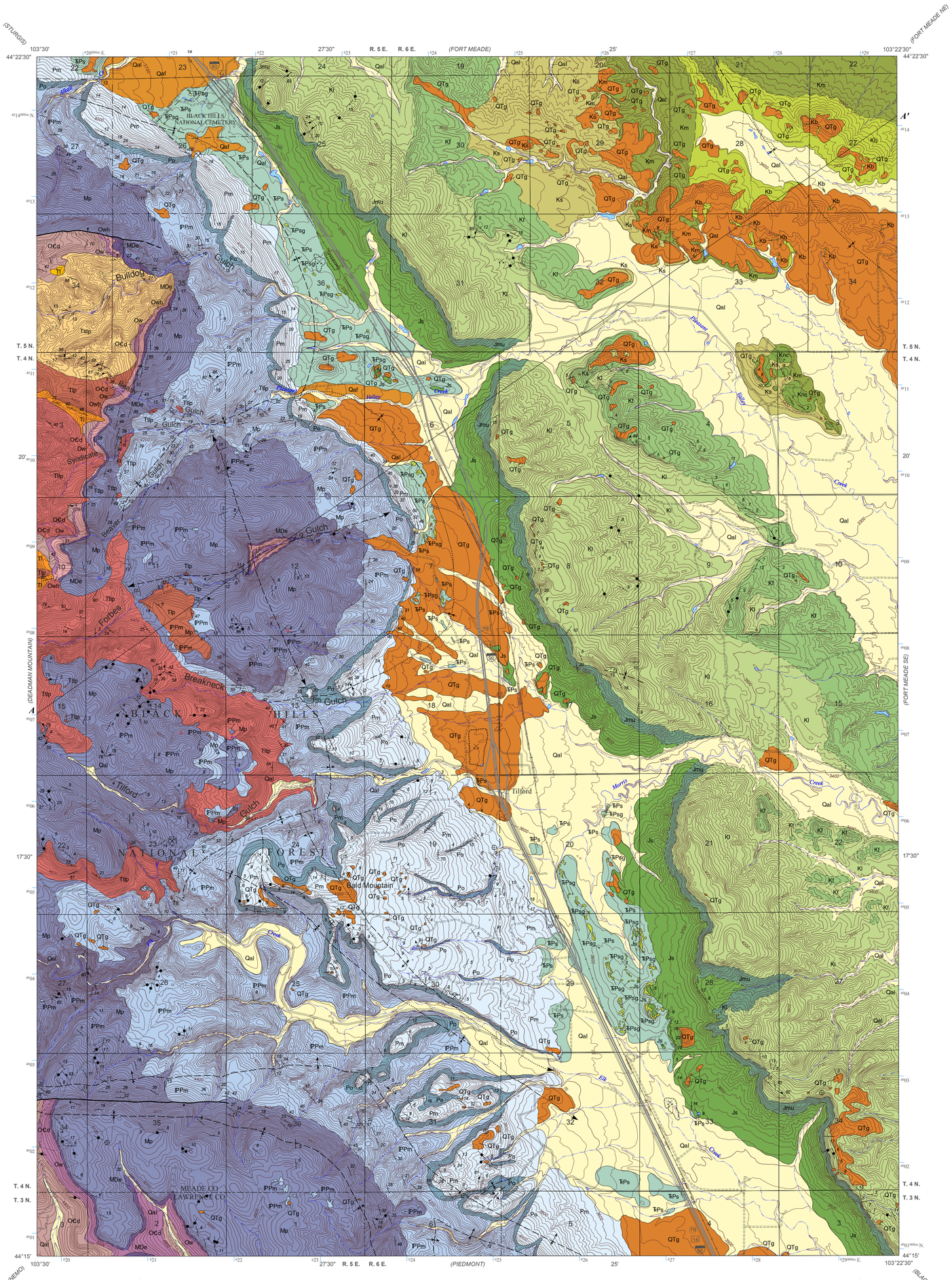
State of South Dakota
Dennis Daugaard, Governor

South Dakota Geological Survey
Derric L. Iles, State Geologist



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Digital cartography by Brian A. Fagnan and Wesley P. Christensen

Map base modified from U.S. Geological Survey 1:24,000-scale Tilford digital line graph.
Projection is Universal Transverse Mercator, Zone 13N.
Datum is 1983 North American.
UTM grid information generated from the ArcMap™ layout grid function.

The Geological Survey Program, Department of Environment and Natural Resources, engages in an ongoing data collection and interpretation process. An outcome of that process is to reflect those interpretations on maps such as this one. Reasonable efforts have been made to ensure that this map accurately reflects the source data used in its preparation. This map is date specific. As additional data become available, geologic interpretations may be revised and the map may be updated by the Geological Survey. This map should not be enlarged or otherwise used in an attempt to interpret more detail than can be seen at a scale of 1:24,000.

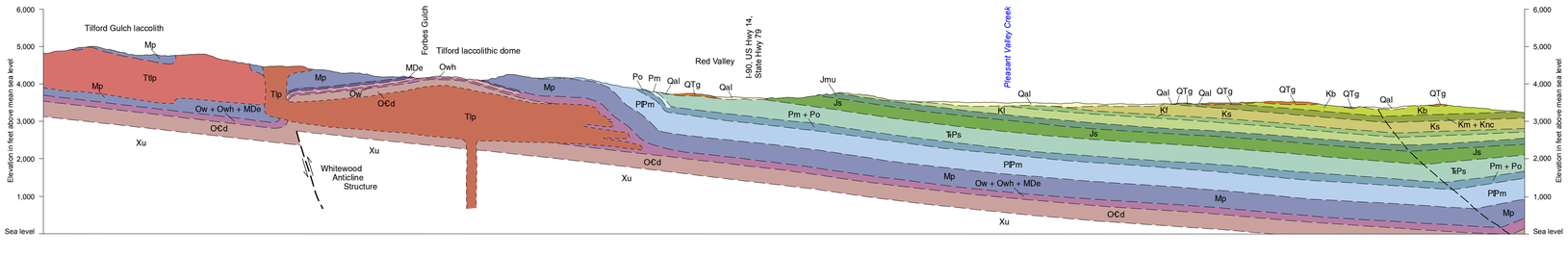
SCALE 1:24,000

1 0.5 0 1 Mile
1,000 0 1,000 2,000 3,000 4,000 5,000 6,000 7,000 Feet
1 0.5 0 1 Kilometer

CONTOUR INTERVAL 20 FEET

NORTH
1°10'
21 MILS
8°22'
148 MILS
APRIL 13, 2011, MAGNETIC NORTH
DECLINATION AT CENTER OF SHEET

Quadrangle location



Department of Environment and Natural Resources
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Geological Survey Program
7.5 Minute Series Geologic Quadrangle Map 22

Prepared in cooperation with the South Dakota School of Mines and Technology, Rapid City, South Dakota

EXPLANATION

Quaternary

- Qal — **Alluvium** - Gravel, sand, silt and clay deposited along streams, as overbank material during floods, and in older, undifferentiated terrace deposits
- Qaf — **Alluvial fan** - Poorly sorted, unconsolidated, mud, silt, sand and gravel deposited at valley mouths along the "Red Valley." Approximate maximum thickness of 30 ft (9 m)
- QTg — **Gravel deposit** - Unconsolidated to loosely consolidated clay- to boulder-sized clasts comprised of Precambrian lithologies and minor Paleozoic carbonate and sandstone. All gravels are sub-rounded to rounded. Some gravel deposits could be associated with the White River Group but were not differentiated in the study area. Some gravel deposits could be associoated with alluvial fans but were undifferentiated

Tertiary

- Tslp — **Sanidine-bearing latite porphyry** - Light gray with aphanitic porphyritic texture; weathers to greenish-tan and brown. Phenocrysts are 1-5% euhedral sanidine (to 16 mm), 20-30% euhedral plagioclase (0.5-5 mm), 1-4% euhedral hornblende (0.2-5 mm) and accessory magnetite. Staining indicates a dominance of potassium feldspar in the groundmass. Comprises the Bulldog Gulch laccolith and a small body along the southwest margin of the Tilford Dome. Locally with trachytic texture and chilled margins
- Tltp — **Sanidine-bearing latite porphyry** - Light gray with aphanitic porphyritic texture; weathers light gray to tan. Phenocrysts are 1-3% euhedral biotite (1 mm), 3-5% euhedral hornblende (less than 2 mm), 25-35% euhedral to subhedral oligoclase (less than 2 mm) and accessory euhedral titanite (1-3 mm), magnetite, apatite, zircon and pyroxene. Staining indicates that the groundmass (25-40% of total rock) is composed of 5-10% quartz, 10% plagioclase and 80% potassium feldspar (Matthews, 1979). Comprises the Tilford Gulch laccolith. Flow sheeting weathers to plates 1-2 inches (2.5-5 cm) thick and may give the appearance of bedding. Locally displays trachytic texture and lineation of hornblende grains. Laccolith thickness of 338 ft (111 m) reported in water well at periphery (Sec. 23, T. 4N., R.5E.)
- Tl — **Latite porphyry** - Light gray with, aphanitic porphyritic texture; weathers to greenish-tan and brown. The fine grains and color give a salt and pepper appearance to the rock. Phenocrysts less than 1mm in size are similar to those of Tltp consisting of plagioclase hornblende and biotite, but lacking titanite. Moderate to steeply dipping flow sheeting is common
- Tlp — **Latite porphyry** - Very light gray to tan with aphanitic porphyritic texture; weathers medium gray to light tan. Texture and composition similar to Tltp, but lacks titanite
- Ttp — **Trachyte porphyry** - Light brown to light gray with aphanitic porphyritic texture; weathers light tan. Phenocrysts are 15% euhedral to subhedral plagioclase (0.5-3 mm) and 2-4% euhedral to subhedral hornblende (0.2-2 mm). Magnetite is an accessory mineral. Staining of groundmass reveals minor quartz and the remainder as potassium feldspar (Matthews, 1979)

Unconformity

Cretaceous

Upper Cretaceous

- Kb — **Belle Fourche Shale** - Dark brownish-black shale with bentonite beds. The basal contact locally contains thin, strongly bioturbated calcarenite beds composed of echinoids spines, pelecypods and minor quartz. The basal 50 ft (16 m) contains iron-manganese concretions up to 10 ft (3 m) in diameter that weather to pebble-sized fragments. The upper contact is not exposed within the quadrangle
- Km — **Mowry Shale** - Light gray siliceous shale and quartz arenite. Siliceous shale weathers to platy chips. Contains numerous bentonite layers and sandstone dikes. Upper portion contains cone-in-cone structures and dense, siderite concretions. The Clay Spur Bentonite Bed (approximately 3 ft) marks the top of the formation. Approximate thickness is 100 ft (33 m)

Lower Cretaceous

- Knc — **Newcastle Sandstone** - White, fine-grained, muscovite-bearing, quartz arenite with low-angle cross beds. Thickness of 0-30 ft (0-9 m)
- Ks — **Skull Creek Shale** - Medium-gray marine shale, with abundant thin beds and lenses of fine-grained quartz sandstone and dark-brown to maroon-weathering, fine-grained concretions. Generally grass covered. Affected by landslides in areas of steep slopes. Approximate thickness is 280 ft (85 m)
- Kf — **Fall River Formation** - Variegated, interbedded, very fine-to fine-grained quartz arenite and mudstone. The upper sandstone is orange tan to light brown, commonly massive, wave-rippled, and transitional to the overlying Skull Creek Shale over a few feet thickness. Fresh samples may have pyrite and abundant mica flakes. Approximate thickness of 120 ft (36 m)

Disconformity

- Kl — **Lakota Formation** - Orange-tan, light-maroon and white, fine-grained, quartz arenite and brown to light-gray mudstone. The basal unit is planar-bedded sandstone locally containing *Skolithus* burrows. The middle portion contains lensoid channel sandstones to 100 ft thick enclosed in brown mudstone. The upper portion contains light gray, maroon, red, and brown mudstone of the Fuson member. Silicified wood is common in the channel deposits and ostracods are abundant in some mudstone layers. Approximate thickness of 200 ft (60 m)

Disconformity

Jurassic

Upper Jurassic

- Jmu — **Morrison Formation and Unkpapa Sandstone** - Variegated claystone, siltstone, and sandstone. Present as grass-covered slopes below sandstone ledges of the Lakota Formation. Beige to white friable dune sandstone, only seen in in float in the southern part of the quadrangle, possibly pinches out. Combined approximate thickness of 110 ft (33 m)

Disconformity

Middle Jurassic

- Js — **Sundance Formation** - Tan to light-gray-green sandstone, siltstone and shale with belemnites in the upper and lower parts of section. Middle part of section includes rose-colored, massive, fine-grained sandstone and siltstone (LAK Member) and white to tan, fine-grained, rippled quartz arenite (Hullet Sandstone Member). Thickness of 330-370 ft (100-113 m)

Disconformity

Triassic

Lower Triassic

- TrPsg / TrPs — **Spearfish Formation** - Red to rose colored mudstone and fine-grained sandstone. Beds of gypsum to 20 ft thick present at base and near top of formation with veins of gypsum throughout. Forms low, grass-covered slopes in the "Red Valley." Thickness of 400-500 ft (122-152 m)

Disconformity

Permian

Upper Permian

- Pm — **Minnekahta Limestone** - Pale lavender, beige, light-gray limestone (micrite). Thin-bedded, with abundant stylolites, kink bands and box folds: stromatolites common at base of section. Thickness of 40-60 ft (12-18 m)

Disconformity

Lower Permian

- Po — **Opeche Shale** - Red to maroon mudstone and siltstone. Lavender zone at top approximately 5 ft (1.5 m) thick. Exposed on slopes beneath Minnekahta Limestone cliffs. Thickness of 105-130 ft (32-39 m)

Disconformity

Pennsylvanian

Upper Pennsylvanian

- PPm — **Minnelusa Formation** - Beige to pale orange, white and gray. Lower portion is medium- to thick-bedded sandstone, dolomite, limestone and shale; upper portion is dominated by thick- to massive-bedded sandstone, strongly deformed by solution of interbedded evaporite beds. Excellent exposures in canyon walls with few outcrops in uplands. Thickness of 400-600 ft (120-180 m)

Disconformity

Mississippian

Lower Mississippian

- Mp — **Pahasapa Limestone** - Beige, to light-gray dolomite and limestone with thin lenses of brown to light-gray chert. Medium to massively bedded: prominent cliffs in canyon walls weather to dark gray. Vuggy, with caves and solution breccia, dominantly in the upper one-half of the formation. The upper contact is an irregular surface, commonly brecciated and locally with a terra rosa horizon at the top. Approximate thickness of 450 ft (135 m)

Devonian

Upper Devonian

- MDe — **Englewood Limestone** - Pink, gray, to purple-gray, argillaceous limestone, dolomite, and shale. Laminated to medium-bedded, finely to medium crystalline; bioturbated, locally containing crinoids and bryozoa. Thickness of 35-55 ft (11-17 m)

Disconformity

Ordovician

Upper Ordovician

- Owh — **Whitewood Limestone** - Variegated, yellowish-brown, brownish-orange to gray, bioturbated dolomitic limestone and dolostone. Thin bedded to massive. Fossils include colonial and solitary corals and orthocone nautiloids. Thickness of 60-80 ft (18-24 m)
- Ow — **Winnipeg Formation** - Glauconitic shale. Poorly exposed in hill slopes beneath ledges of Whitewood formation in the northern part of the quadrangle. Approximate thickness of 55 ft (17 m). May include beds of Whitewood Limestone dolomite in the southern outcrops

Disconformity

Cambrian

Lower Ordovician / Upper Cambrian

- OCd — **Deadwood Formation** - Uppermost part of the section is composed of *Skolithus*-bearing, heavily iron-stained, non-glauconitic, quartz arenite. This overlies greenish- to reddish-brown, glauconitic sandstone, shale, limestone, and intraformational conglomerate. Thin to thick beds. Basal contact is not exposed. Estimated thickness of 400 ft (120 m)

Unconformity

Precambrian

- Xu — **Undifferentiated Precambrian rocks** - Shown only in cross section

Contact
Long dashed where approximately located; short dashed where inferred by air photo; queried in cross section

FAULTS
Fault
Long dashed where approximately located; short dashed where inferred in cross section; dotted where concealed. Bar and ball on downthrown side

FOLDS
Anticline
Location of trace of axial surface and direction of plunge. Long dashed where approximately located; short dashed where inferred in cross section; dotted where concealed

Syncline
Location of trace of axial surface and direction of plunge. Long dashed where approximately located; short dashed where inferred in cross section; dotted where concealed

Monocline, anticlinal bend
Shorter arrow indicates steeper beds. Long dashed where aproximatley located; dotted where concealed

Monocline, synclinal bend
Shorter arrow indicates steeper beds. Long dashed where aproximatley located; dotted where concealed

Small anticline
Showing bearing and plunge

Dome
Location of trace of axial surface and direction of plunge. Long dashed where approximately located

STRIKE AND DIP OF BEDDING
Inclined — 33
Vertical
Horizontal

STRIKE AND DIP OF FLOW FOLIATION IN IGNEOUS ROCKS
Inclined — 33

STRIKE AND DIP OF FRACTURES
Inclined — 33
Vertical
Multiple — 65
Point of observation where symbols join

KARST FEATURE
Breccia pipe

OTHER FEATURES
- Open pit mine or glory hole
- Gravel pit
- Mine shaft
- Mine adit or cave
- Group of prospect pits
- Prospect pit
- Outline of open pit mine or quarry

Selected References

Matthews III, C.B., 1979, *Geology of the central Vanocker laccolith area, Meade County, South Dakota*: Rapid City, S. Dak., South Dakota School of Mines and Technology, M.S. thesis, 110 p.

Redden, J.A., 2009, *Geologic map of the Piedmont quadrangle, South Dakota*: South Dakota Geological Survey 7.5 minute series Geologic Quadrangle Map 10, scale 1:24,000.

Redden, J.A., and DeWitt, E., 2008, *Maps showing geology, structure, and geophysics of the central Black Hills, South Dakota*: U.S. Geological Survey Scientific Investigations Map 2777, scale 1:100,000.

Rockey, D.L., 1974, *Geology of the eastern Vanocker laccolith area, Meade County, South Dakota*: Rapid City, S. Dak., South Dakota School of Mines and Technology, M.S. thesis 44 p.

South Dakota Department of Environment and Natural Resources: Water Well Completion Reports: http://denr.sd.gov/des/wr/dblogsearch.aspx

Acknowledgements

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