GEOLOGIC MAP OF THE DEERFIELD QUADRANGLE, SOUTH DAKOTA

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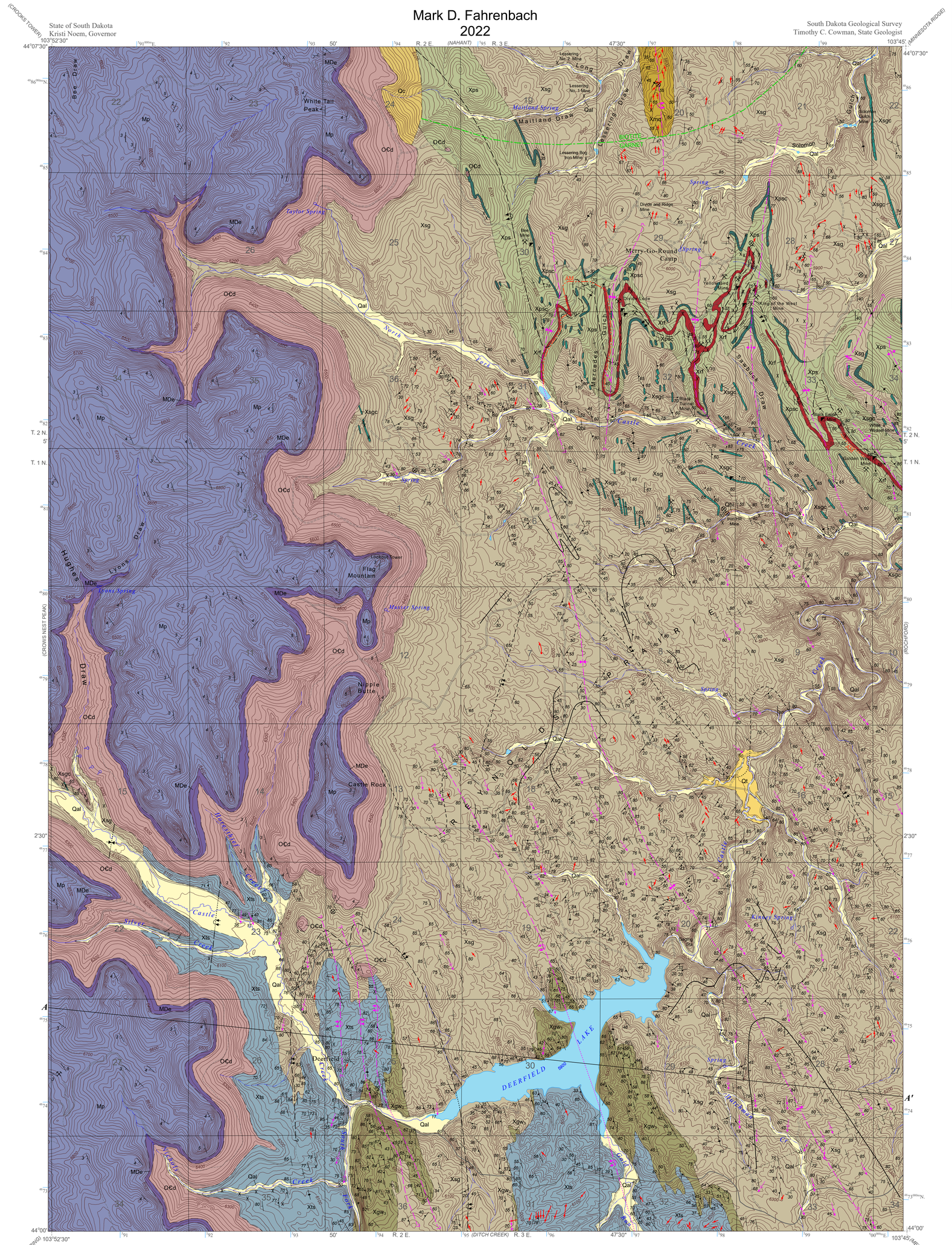
DEPARTMENT OF AGRICULTURE AND NATURAL RESOURCES
DIVISION OF FINANCIAL AND TECHNICAL ASSISTANCE
GEOLOGICAL SURVEY PROGRAM
7.5 MINUTE SERIES GEOLOGIC QUADRANGLE MAP 33



Map base modified from U.S.G.S. 1:24,000-scale Deerfield 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, South Dakota Department of Agriculture 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. As additional data become available, geologic interpretations may be revised and the map may be updated by the Geological Survey Program. This map should not be enlarged or otherwise used in an attempt to interpret more detail than can be seen at the 1:24,000 scale.

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

UTM GRID AND 2021 MAGNETIC NORTH DECLINATION AT CENTER OF MAP
MN GN
0° 49' 15 MILS
7° 33' 134 MILS

Digital Cartography by M.D. Fahrenbach

SOUTH DAKOTA
QUADRANGLE LOCATION

EXPLANATION

QUATERNARY

- Qal — **Alluvium** - Unconsolidated to poorly consolidated, angular to rounded clasts to boulder-size. May include adjacent terrace deposits. Deposited in present day stream drainages
- Qc — **Colluvium** - Unconsolidated, poorly sorted, angular clasts to boulder-size of locally derived material and soil. Deposited along steep slopes
- Qt — **Terrace deposit** - Unconsolidated to poorly consolidated, angular to rounded clasts to boulder-size. Deposited adjacent to present day streams. Only larger deposits are shown. Maximum thickness approximately 30 ft (9.1 m)
- Qbi — **Bog iron deposit** - Unconsolidated to consolidated, angular to rounded clasts to boulder-size cemented by iron-oxides. Typically forms from seeps, springs, and along streams flowing through sulfide-bearing rocks

Unconformity

MISSISSIPPIAN / Lower Mississippian

- Mp — **Pahasapa Limestone** - Limestone and dolomitic limestone. Grayish-white to gray. Finely to medium crystalline, medium- to very thick-bedded. Karstic, with dissolution dominantly in the upper third of the formation. Forms prominent cliffs. Contains rugose corals and spiriferid brachiopods, especially near the upper contact. Exposed thickness approximately 200 ft (61 m)

DEVONIAN / Upper Devonian

- MDe — **Englewood Formation** - Limestone, dolomitic limestone, and shale. Pink, purple-gray, to gray. Thinly laminated to thin-bedded with abundant stylolite surfaces. Limestones are medium to very finely crystalline and typically argillaceous. Invertebrate fossils are rare, however beds are usually highly bioturbated. Typically covered by colluvium and poorly exposed. Thickness approximately 50 ft (15.2 m)

Disconformity

ORDOVICIAN / Lower Ordovician

CAMBRIAN / Upper Cambrian

- OCd — **Deadwood Formation** - Basal conglomerate and conglomeratic sandstone locally over 20 ft (6.1 m) thick, containing rounded to well-rounded quartz pebbles as much as 3 in (7.6 cm) in diameter derived from quartz veins. Overlain by tan, brown, to reddish-brown, medium-grained, moderately sorted, medium- to thick-bedded, locally cross bedded sandstone and orthoquartzite. Includes thin- to medium-bedded greenish glauconitic sandstone, intraformational conglomerate, siltstone, and shale. Formation is typically covered by colluvium and poorly exposed. Thickness approximately 200-250 ft (61.0-76.2 m)

Unconformity

PRECAMBRIAN / Lower Proterozoic

- Xsg / Xsgc — **Swede Gulch Formation** - **Xsg**- Micaceous phyllite, schist, and metagraywacke. Gray to black. Composed of 35-70% to as much as 90% biotite, and 25-50% angular 0.01-0.05 mm quartz grains. Pale-red to black garnets having graphite inclusions occur at higher metamorphic grades. Laminated to medium-bedded. Bedding is indicated by 0.5-2.0 in (1.3-5.1 cm) thick garnetiferous beds and light-dark layering. Contains chloritic layers and accessory magnetite, ilmenite, and pyrite. Lower carbonaceous and graphitic portion probably grades into the Poverty Gulch Slate (Xps). Poorly exposed. Laterally equivalent to the Grizzly Formation of the northern Black Hills (Bayley, 1972a; Kuhl, 1982). Protoliths are shale, carbonaceous shale, minor siltstone, and chert. **Xsgc** - Metachert, medium- to thick-bedded and massive, having light-dark layering. Typically ferruginous and iron-stained. One to several beds are interbedded with graphitic slate and schist about 100 ft (30.5 m) above the base of the formation (Bayley, 1972a; Kuhl, 1982)

Unconformity ?

- Xgw3 — **Metagraywacke unit 3** - Quartzite, quartz-mica schist, and phyllite. Brownish-gray, gray, to dark-gray. Thick- to thin-bedded with some schistose beds. Composed of 65-80% subrounded quartz grains up to 0.1 in (2.5 mm) diameter, as much as 5% mica, and a trace of feldspar, chlorite, garnet, and magnetite. Some beds are graded. Quartz-rich Bouma A beds locally contain calcareous and calc-silicate concretions and are resistant to erosion, forming prominent blocky outcrops. Absent in places possibly due to nondeposition (Kuhl, 1982). Protolith is proximal turbidite deposits having sandstone and graywacke with minor shale interbeds
- Xpsc / Xts / Xps — **Poverty Gulch Slate** - **Xps** - Slate and phyllite. Dark-brown to black. With interbedded black graphitic slate and schist. Laminated to thin-bedded, with alternate laminae typically containing abundant small garnets (Bayley, 1972a). Laterally equivalent to the Tenderfoot Formation (Xts), and the Flag Rock Formation of the northern Black Hills. Protolith of formation is shale, siltstone, tuffaceous volcaniclastic sediments, carbonate- and silicate-facies iron-formation, and chert beds. **Xpsc** - Metachert, medium- to thick-bedded, having light-dark layering, ferruginous. Mainly occurs at the top of the formation
  Tenderfoot Formation - **Xts** - Micaceous phyllite and schist, laminated to thin-bedded. Green- to silver-gray, gray, to dark-gray. Composed of 15-60% muscovite, 10-35% biotite, and 25-45% quartz. Bedding is indistinct, indicated by thin micaceous and garnetiferous layers. Some biotite is replaced by chlorite. Typically has 2-5% to as much as 20% accessory magnetite, some altered to hematite, and a trace of ilmenite. Locally with malachite-stained muscovite-rich schist and thin spessartine-bearing beds. Iron-stained near the contact with the Deadwood Formation (Kuhl, 1982). Includes some metagraywacke beds which increase in abundance to the north and cannot be distinguished from metagraywacke units on adjacent quadrangles (Redden and DeWitt, 2008). Protolith of formation is alumina-rich seafloor weathered alkalic volcaniclastic sediments, volcanic tuff, and shale. Laterally equivalent to the Poverty Gulch Slate (Xps), and ash flow tuffs in the Rochford area. Approximate age of 1,880 Ma (Redden and others, 1990)
- Xrf — **Rochford Formation** - Metachert, thick- to thin bedded, ferruginous. Dark greenish-gray, weathering dark reddish-brown. Composition variable, averaging 77% cummingtonite-grunerite, 10% chlorite, 5% almandite, 5% sulfides, 4% graphite, 4% carbonate, 3% biotite, and 2% quartz. Dominantly metachert on straight fold limbs, with cummingtonite-grunerite on tight fold noses. Upper and lower contacts conformable. Thickness approximately 50-375 ft (15.2-114.3 m) (Bayley, 1972a). Lithologically similar to the Montana Mine Formation on adjacent quadrangles, and the Homestake Formation of the northern Black Hills. Age estimated less than 1,887 Ma (Frei and others, 2009). Protolith is likely submarine thermal spring deposits
- Xmq — **Moonshine Gulch Quartzite** - Metagraywacke and quartzite. Gray to dark-gray. Composed of medium- to coarse-grained, sub-rounded to rounded, moderately to poorly sorted quartz grains. Thin- to medium-bedded with prominent layering. Some beds are graded. Quartzose beds may contain abundant feldspar grains and as much as 40% micaceous minerals. Silica cement gives a vitreous luster on fresh surfaces of some beds. Interbedded with silver-gray and black-banded carbonate, and sericitic to micaceous and graphitic slate and phyllite. Pyrite occurs as disseminated grains. Inferred to intertongue with the Nahant Schist on adjacent quadrangles. Laterally equivalent to the Ellison Formation of the northern Black Hills (Bayley, 1972a; Kuhl, 1982). Protolith is proximal turbidite deposits having sandstone, graywacke, siltstone, and shale

CONTACTS

- Long dashed where approximately located; short dashed where inferred; queried where uncertain in cross section; arrow indicates dip direction and amount

FOLDS (Early Proterozoic)

D_1 FOLDS

- Overturned anticline — Location of trace of axial plane and dip direction of limbs. Long dashed where approximately located; dotted where concealed; queried where uncertain
- Syncline — Location of trace of axial plane. Long dashed where approximately located; dotted where concealed; queried where uncertain
- Overturned syncline — Location of trace of axial plane and dip direction of limbs. Long dashed where approximately located; short dashed where inferred; dotted where concealed; queried where uncertain

D_2 FOLDS

Typically trending northwest, and plunging to the southeast

- Anticline — Location of trace of axial plane. Long dashed where approximately located; dotted where concealed; queried where uncertain
- Overturned anticline — Location of trace of axial plane and dip direction of limbs. Long dashed where approximately located; dotted where concealed; queried where uncertain
- Syncline — Location of trace of axial plane. Long dashed where approximately located; dotted where concealed; queried where uncertain
- Overturned syncline — Location of trace of axial plane and dip direction of limbs. Long dashed where approximately located; dotted where concealed; queried where uncertain
- Minor fold — Showing bearing and plunge. Where multiple small antiformal and synformal folds occur
- Minor antiform — Showing bearing and plunge
- Minor synform — Showing bearing and plunge

BEDDING

- Inclined
- Overturned — Where direction of younging known. Top direction of beds is opposite dip direction
- Vertical
- Top of Bed — Indicated by sedimentary structures

FOLIATION

- Inclined
- Inclined, parallel to foliation
- Vertical
- Crenulation

LINEATION

- Lineation — Showing bearing and plunge. Southeast trends are dominantly D_2 in age

FORM LINE

- Tic indicates generalized dip direction of beds. Modified from Bayley (1972b)

QUARTZ VEIN

METAMORPHIC ISOGRAD

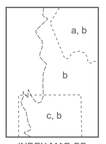
- BIOTITE / GARNET — First appearance of index mineral noted on side of isograd

MAGNETIC HIGH

- AM — Located by aerial magnetic survey (Bayley, 1972a)

OTHER FEATURES

- Open pit mine or glory hole
- Mine shaft
- Mine adit
- Trench
- Group of prospect pits
- Prospect pit



INDEX MAP OF SELECTED REFERENCES

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Small synformal fold in the Swede Gulch Formation (Xsg) plunging to the southeast was produced by D_2 deformation. Hammer at top of picture is 16 in (40.6 cm) long with the handle pointing down the fold axis.

Contact of resistant beds of Metagraywacke unit 3 (Xgw_3) on the left with grass-covered slope of Swede Gulch Formation (Xsg), located at the west end of Deerfield Lake.

Basal conglomerate of the Deadwood Formation (OCd) over 20 ft (6.1 m) thick exposed above Horsethief Creek. Composed predominantly of rounded quartz pebbles derived from quartz veins. Thick sections are typically deposited in paleo-topographic lows and tidal channels.

View east from Whitetail Peak, elevation 6962 ft (2,121.9 m), over tree-covered and treeless areas of Reynolds Prairie underlain by the Swede Gulch Formation (Xsg). Black Elk Peak, elevation 7,242 ft (2,207.3) m), is the highest peak on the left horizon. Grass-covered Pahasapa Limestone (Mp) is in the foreground.

Northeast dipping resistant metachert (Xsgc) in the lower Swede Gulch Formation (Xsg) having prominent light-dark layering. A portion of quartz vein is at the lower right.

Relic bedding in the Swede Gulch Formation (Xsg) shown by alternating light-dark layering. The darker beds are biotitic and garnetiferous.

Subtle exposure of Swede Gulch Formation (Xsg) with southeast dipping foliation in the treeless area of Reynolds Prairie. The formation is typically poorly exposed.