GEOLOGIC MAP OF THE NAHANT QUADRANGLE, SOUTH DAKOTA

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State of South Dakota
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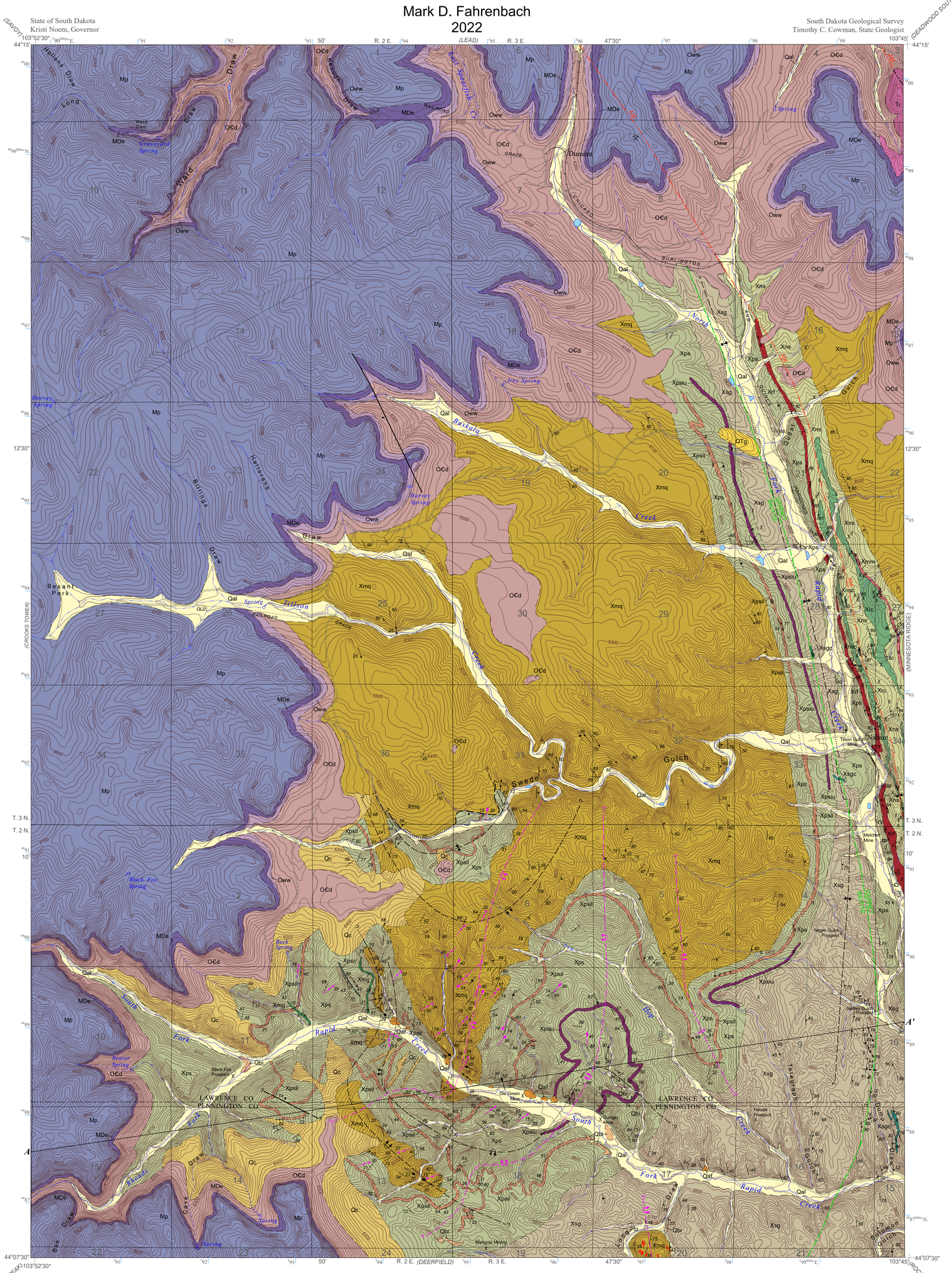
SOUTH DAKOTA DEPARTMENT OF AGRICULTURE AND NATURAL RESOURCES
DIVISION OF FINANCIAL AND TECHNICAL ASSISTANCE
GEOLOGICAL SURVEY PROGRAM
7.5 MINUTE SERIES GEOLOGIC QUADRANGLE MAP 34



Map base modified from U.S.G.S. 1:24,000-scale Nahant 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.

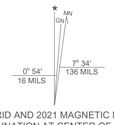
The Geological Survey Program, South Dakota Department of Agriculture and Natural Resources, engages in an ongoing data collection and interpretation process. An outcome of that process is to reflect those interpretations on maps such as this one. Reasonable efforts have been made to ensure that this 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 Mile 0 0.5 1
7,000 Feet 1,000 0 1,000 2,000 3,000 4,000 5,000 6,000
1 Kilometer 1 0.5 0

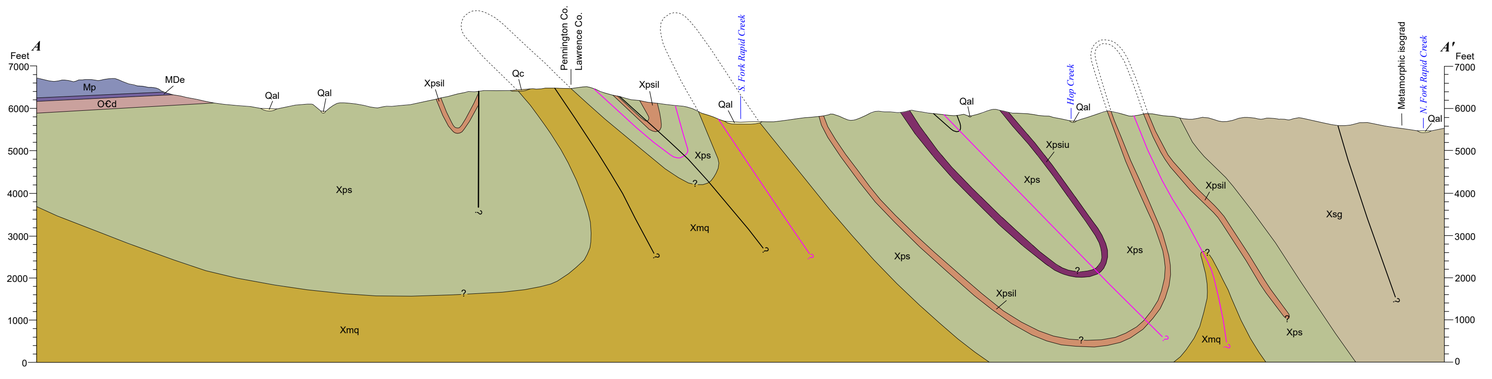
CONTOUR INTERVAL 20 FEET

Digital Cartography by M.D. Fahrenbach



UTM GRID AND 2021 MAGNETIC NORTH DECLINATION AT CENTER OF MAP

QUADRANGLE LOCATION



EXPLANATION

QUATERNARY

- Qal — **Alluvium** - Unconsolidated to poorly consolidated, clasts to boulder-size. Includes adjacent terrace deposits. Deposited in present day stream drainages
- Qc — **Colluvium** - Unconsolidated to poorly consolidated, clasts to boulder-size of locally derived material mixed with soil. Deposited along steep slopes
- Qaf — **Alluvial fan deposit** - Unconsolidated to poorly consolidated, clasts to boulder-size of locally derived material. Deposited at the mouths of stream drainages
- Qbi — **Bog iron deposit** - Unconsolidated to consolidated, angular to rounded clasts to boulder-size typically cemented by iron-oxide. Occurs as deposits of former springs on hillsides as much as 60 ft (18.3 m) above present day streams, and in present day drainages
- QTg — **Gravel deposit** - Unconsolidated to poorly consolidated, clasts to boulder-size. Deposited from 20-80 ft (6.1-24.4 m) above present-day drainages

Nonconformity

TERTIARY

- Tr — **Rhyolite** - Finely crystalline to aphanitic groundmass dominantly of potassium feldspar. Leucocratic, white, tan, to pinkish-white where fresh, weathering gray to yellowish-brown. Iron- and manganese-stained, locally with prominent flow banding. May have sericitic or argillic alteration

Unconformity

MISSISSIPPIAN — Lower Mississippian

- Mp — **Pahasapa Limestone** - Limestone to dolomitic limestone. Grayish-white to gray. Finely to medium crystalline, thin- to thick-bedded in the lower portion of the formation, thick-bedded in the upper portion. 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 350-400 ft (106.7-121.9 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; bioturbated. Limestones are very finely to medium crystalline and typically argillaceous. Thickness 40-50 ft (12.2-15.2 m)

Disconformity

ORDOVICIAN — Upper Ordovician

- Oww — **Whitewood Limestone and Winnipeg Formation (undifferentiated)** - **Whitewood Limestone** - Dolomitic limestone and dolomite. Variegated yellowish-brown, brownish-orange, to gray. Thin- to thick-bedded with thin shale partings; bioturbated. **Winnipeg Formation** - Greenish-gray fissile shale and tan calcareous siltstone. Combined thickness of units approximately 40-50 ft (12.2-15.2 m). Thins to the south to 0 ft (0 m)

Lower Ordovician

- OCd — **Deadwood Formation** - Basal conglomerate and conglomeratic sandstone locally over 25 ft (7.6 m) thick containing subrounded to well-rounded quartz pebbles up to 3 in (7.6 cm) in diameter derived from local 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)

CAMBRIAN — Upper Cambrian

Unconformity

PRECAMBRIAN — Lower Proterozoic

- Xsg / Xsgc — **Swede Gulch Formation** - **Xsg** - Slate, 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 garnet with 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 layers 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). Gradational into the Grizzly Formation (Xg) of the northern Black Hills (Bayley, 1972a). Poorly exposed. Protoliths of formation are shale and carbonaceous shale, minor siltstone, and chert. **Xsgc** - Metachert, medium- to thick-bedded and massive with light-dark layering. Finely to medium crystalline having a sucrosic texture. Typically ferruginous and iron-stained. Interbedded with graphitic slate and schist and mainly occurring in the lower portion of the formation

Unconformity?

- Xmg — **Metagabbro** - Amphibolite and chloritic amphibole schist. Grayish-green, dark-green, to brown. Finely to coarsely crystalline, locally foliated and schistose. Composed of 30-50% amphibole, 20-30% plagioclase, 10-30% chlorite, and minor calcite, biotite, and quartz. Contains accessory sphene and ilmenite. Thickness 75-100 ft (22.9-30.5 m), however bodies do occur that are too thin to show at map scale (Wynn, 1992). Protolith is gabbroic dikes and sills
- Xpsiu / Xpsc / Xps / Xpsil — **Poverty Gulch Slate** - **Xps** - Biotitic slate and phyllite with interbedded graphitic slate and schist. Dark-brown to black. Laminated to thin-bedded, with alternate laminae typically containing abundant small garnets. Protolith of formation is shale, siltstone, tuffaceous volcaniclastic sediments, carbonate- and silicate-facies iron-formation, and chert beds. Laterally equivalent to the Tenderfoot Formation (Xts) on adjacent quadrangles. Gradational into the Flag Rock Formation (Xf) of the northern Black Hills (Bayley, 1972a). **Xpsc** - Metachert, finely to coarsely crystalline, with light-dark layering and a sucrosic texture, ferruginous. **Upper Iron-Formation** - **Xpsiu** - Metachert, thin-bedded, medium to coarsely crystalline, having light-dark layering and a sucrosic texture. Metachert beds make up to 60% of the rock. Some weathered beds have formed an iron-stained gossan from oxidation of sulfides. Contains more chert and carbonate phyllite than the Lower Iron-Formation (Xpsil). Thickness 50-100 ft (15.2-30.5 m) (Wynn, 1992). **Lower Iron-Formation** - **Xpsil** - Metachert, thin- to thick-bedded, blocky and massive. Black, brown, to reddish-brown. Finely to coarsely crystalline, having light-dark layering and a sucrosic texture, biotitic, ferruginous. Thin 0.1-1.0 in (0.25-2.5 cm) thick chert beds make up 30-50% of the rock. Includes interbedded biotitic and carbonaceous phyllite, and iron-carbonate. Thickness 50-100 ft (15.2-30.5 m) (Wynn, 1992)
- 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 garnet, 5% sulfide, 4% graphite, 4% carbonate, 3% biotite, and 2% quartz. Dominantly metachert on straight fold limbs, with rosettes of cummingtonite-grunerite on tight fold noses. Upper and lower contacts are conformable (Weissenborn, 1987). Lithologically similar to the Montana Mine Formation (Xmm), and the Homestake Formation (Xhs) of the northern Black Hills (Bayley, 1972a). Thickness approximately 50 ft (15.2 m) to as much as 375 ft (114.3 m). Age estimated less than 1,887 Ma (Frei and others, 2009). Protolith is likely submarine thermal spring deposits
- Xns / Xnsc / Xrc — **Nahant Schist** - **Xns** - Graphitic slate and schist. Dark-gray to black. Bedding inconspicuous. A chert-grunerite unit is present at the base of the formation. Intertongues with the Rapid Creek Greenstone (Xrc). Protolith of formation is shale, carbonaceous shale, tuffaceous volcaniclastic sediments, and chert beds. Areas mapped as Irish Gulch Slate by Bayley (1972a) have been included with the Nahant Schist. Gradational into the Flag Rock Formation (Xf) of the northern Black Hills. **Xnsc** - Metachert, having light-dark layering, ferruginous. Interbedded with phyllite and carbonaceous phyllite
  Rapid Creek Greenstone - **Xrc** - Metabasalt, schistose calcareous mafic tuff, agglomerate, and weakly foliated amphibolite having abundant actinolite. Green, greenish-gray, to black. Dense, massive, forming resistant ridges. Has interbedded layered metachert. Intertongues with the Nahant Schist (Xns) (Bayley, 1972a). Protolith is pillowed submarine basalt flows
- Xmm — **Montana Mine Formation** - Metachert containing cummingtonite-grunerite and chloritic schist, and graphitic and volcaniclastic interbeds. Dark grayish-green to brown, weathering dark reddish-brown. Thin- to thick-bedded, ferruginous. Consists of approximately 43% quartz, 38% cummingtonite-grunerite, 13% chlorite, 4% sulfide, 1% biotite, and minor almandite garnet. Locally with poorly sorted angular chert fragments that increase in angularity and size up to 1.5 ft (0.46 m) south of the Montana Mine. Poorly exposed. Thickness 40-80 ft (12.2-24.4 m) (Weissenborn, 1987). Lithologically similar to the Rochford Formation (Xrf), and the Homestake Formation (Xhs) of the northern Black Hills (Bayley, 1972a). $^{207}Pb/^{206}Pb$ dating of zircon in an interbedded felsic tuff gave an age of 1,884 +/- 29 Ma (Redden and others, 1990). Protolith is likely submarine thermal spring deposits
- Xmq — **Moonshine Gulch Quartzite** - Quartzite and metagraywacke, thin- to thick-bedded with prominent layering. Gray to nearly black. Medium- to coarse-grained, subrounded to rounded, moderately to poorly sorted, with silica cement. Interbedded with gray- and black-layered sericitic to micaceous and graphitic slate. Some beds are graded and indicate tops of beds are generally to the east. Grades into mainly metagraywacke to the south. Pyrite occurs as disseminated grains and flakes. The formation is intruded by thin, schistose sills of metagabbro (Xmg) that are altered to chlorite but too small to show at map scale. Protolith is proximal turbidite deposits having sandstone, graywacke, siltstone, and shale. Laterally equivalent to the Ellison Formation (Xe) of the northern Black Hills (Bayley, 1972a)

CONTACTS

Long dashed where approximately located; short dashed where difficult to separate formations due to facies changes; dotted where concealed or where projected above land surface on cross section; queried where uncertain on cross section

FAULTS

Fault
Long dashed where approximately located; dotted where concealed; queried where uncertain. Bar and ball on downthrown side

FOLDS (Early Proterozoic)

D_1 FOLDS

- Syncline — 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
- 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 (40) — Showing bearing and plunge

D_2 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
- 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 (37) — Showing bearing and plunge

BEDDING

- (75) Inclined
- (60) Inclined — Ball indicates top direction of beds known to be in dip direction
- Vertical
- (60) Overturned
- (71) Overturned — Ball indicates top direction of beds known to be opposite dip direction
- Top of bed — Direction of younging shown by sedimentary structures

FOLIATION

- (83) Inclined
- (61) Parallel to bedding
- (70) Crenulated
- Vertical

LINEATION

- (55) Lineation (undifferentiated) — Showing bearing and plunge
- (42) Lineation — Showing bearing and plunge. Likely D_1 in age
- (24) Lineation — Showing bearing and plunge. Likely D_2 in age

METAMORPHIC ISOGRAD

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

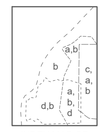
MAGNETIC HIGH

AM — Located by aerial magnetic survey (Bayley, 1972a, 1972b). Shown in black when on rhyolite (Tr)

QUARTZ VEIN

OTHER FEATURES

- Open pit mine
- Mine adit
- Trench
- x Prospect pit



INDEX MAP OF SELECTED REFERENCES

ACKNOWLEDGEMENTS

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c) Weissenborn, P.R., 1987, *The Precambrian geology of the western portion of the Rochford gold-mining district, Black Hills, South Dakota:* Rapid City, South Dakota School of Mines and Technology, M.S. thesis, 143 p.

d) Wynn, J.L., 1992, *The structural geology of the Hop Creek area near Rochford, South Dakota:* Rapid City, South Dakota School of Mines and Technology, M.S. thesis, 59 p.

Foliated Rapid Creek Greenstone (Xrc) on Forest Service Road 17. Thin light-colored lenses of carbonate are upper right of scale.

Thin east-dipping bedding of the Swede Gulch Formation (Xsg) shown by light-dark layering. On Forest Service Road 231. Hammer is 16 in (40.6 cm) long.

Collapsed portal to a mine developed in very carbonaceous Poverty Gulch Slate (Xps). Small crystals of pyrite are present on the mine dump, with some altered to limonite.

Quartz veins in iron-stained Rochford Formation (Xrf) on Forest Service Road 17. The formation was heavily prospected for gold mineralization, however most production was to the east on the Rochford and Minnesota Ridge quadrangles.

Bog iron deposit (Qbi) forming along the South Fork of Rapid Creek. Reflective area is standing water from seeps that contains a high iron content from flowing through rocks with abundant sulfides. Alluvial clasts are cemented with iron oxides.

Box fold in the Moonshine Gulch Quartzite (Xmq) having a shallow plunge to the south. On Forest Service Road 231. Hammer is 16 in (40.6 cm) long.

Southeast plunging D_2 chevron folds in the Poverty Gulch Slate (Xps) on Forest Service Road 231. Hammer at lower right is 16 in (40.6 cm) long.