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LINEAR FEATURES DETERMINED FROM LANDSAT IMAGERY IN SOUTH DAKOTA AND PARTS OF ADJACENT STATES

By

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IDENTIFICATION AND PLOTTING OF LINEAR FEATURES

This map is one of a series of linear-features maps compiled for the U.S. Geological Survey's Northern Great Plains Regional Aquifer System Analysis (U.S. Geological Survey, 1979). This map shows the linear features that were recognized in South Dakota. Other maps in the series cover Wyoming (Cooley, 1983a), Montana (Cooley, 1983b), and North Dakota (Cooley, 1983c).

Linear features occur on the Earth's surface as straight or slightly curved lines. These features often are referred to as linear trends or lineaments, some of which extend across South Dakota. The linear features shown on this map are not identified as to type or origin, although most probably reflect fractures or fracture zones, including joints and faults. Fracture zones affect the movement of water and other fluids through the rocks.

The linear features were determined from visual inspection of color-infrared composites of Landsat imagery at a scale of 1:500,000. The imagery used was the best available as determined by the Geological Survey EROS Data Center at Sioux Falls, South Dakota. The images were obtained during the spring and autumn and are free of cloud cover. All images had been enhanced to remove scan lines that tend to mask some of the features, including linear features.

Physiographic features and tonal differences in vegetation and soils were used to identify the linear features. Physiographic features include straight segments of escarpments, ridges, canyons, and valleys, and the ridge-and-valley topography of badlands. Vegetation growing on flood plains accentuates the configuration of shallow valleys in areas of low relief. On plains and broad slopes that have slight surface relief, tonal contrasts in color patterns of different vegetation and soils helped in the recognition or extension of some of the linear features.

In the broad, gentle plains of eastern South Dakota, the linear features are partly masked by the effects of extensive farming. The rectangular pattern of cultivated fields and the roads along section lines make it difficult to recognize linear features that trend nearly due east or due north. Therefore, in eastern South Dakota there are fewer east- and north-trending linear features plotted on the map than in the western part of the State.

The linear features were plotted as dashed lines on transparent overlays on the Landsat images only in locations where they were observed. Dashed lines were used because most of the linear features were observed as discontinuous lines. The most conspicuous linear features were plotted first and, except for mountainous or upland areas, were usually the longest linear features.

The major and subordinate linear features were classified according to their length into the four groups shown on the map. Determination of the length of the linear features that extend beyond South Dakota was aided by plotting the linear features from a mosaic of Landsat imagery of the United States (scale 1:3,000,000) compiled by the U.S. Soil Conservation Service (1974).

REFERENCES

Cooley, M. E., 1983a, Linear features determined from Landsat imagery in Wyoming: U.S. Geological Survey Open-File Report 83-935, map, scale 1:500,000.

——1983b, Linear features determined from Landsat imagery in Montana: U.S. Geological Survey Open-File Report 83-936, map, scale 1:500,000, 2 sheets.

——1983c, Linear features determined from Landsat imagery in North Dakota: U.S. Geological Survey Open-File Report 83-937, map, scale 1:500,000.

Darton, N. H., 1951, Geologic map of South Dakota: U.S. Geological Survey map, scale 1:500,000.

U.S. Geological Survey, 1979, Plan of study for the Northern Great Plains Regional Aquifer-System Analysis in parts of Montana, North Dakota, South Dakota, and Wyoming: U.S. Geological Survey Water-Resources Investigations Report 79-36, 20 p.

U.S. Soil Conservation Service, 1974, Mosaic of imagery from Earth Resources Technology Satellite-1 of the conterminous United States: U.S. Geological Survey map, scale 1:3,000,000.

EXPLANATION

CORRELATION OF MAP UNITS

Qd	Quaternary	CENOZOIC
Ts, Tr	Tertiary	CENOZOIC
MzPz		MESOZOIC TO PALEOZOIC
pEr		PRECAMBRIAN

DESCRIPTION OF MAP UNITS

Qd DUNE DEPOSITS OF QUATERNARY AGE—Unconsolidated dune sand covers only a small area in southwestern South Dakota but a much larger area in northern Nebraska. Linear features are concealed in areas of dune sand

Ts SEDIMENTARY ROCKS OF TERTIARY AGE—Shale and sandstone. Tertiary sedimentary rocks form broad, gentle surfaces that are present in large areas of western South Dakota to the north and east of the Black Hills. Linear features are easily seen in the Tertiary sedimentary rocks, but where surface relief is low, the linear features may be poorly shown on Landsat imagery. In areas having moderate relief or badlands, including the widespread badlands in the White River drainage area, the linear features are easily seen on Landsat imagery

Tr INTRUSIVE ROCKS OF TERTIARY AGE—Mainly monzonite. Tertiary intrusive rocks are present only in small exposures in the northern part of the Black Hills. The linear features are not as clearly developed on the Tertiary intrusive rocks as they are on the nearby basement and sedimentary rocks

MzPz SEDIMENTARY ROCKS OF MESOZOIC TO PALEOZOIC AGE—Shale, sandstone, and minor limestone. Mesozoic and Paleozoic sedimentary rocks are present throughout most of South Dakota. Linear features generally are easily seen on Landsat imagery in areas of the Black Hills having differential erosion and in areas having moderate surface relief. Where the sedimentary rocks are overlain by glacial deposits, the linear features are not as easily seen on Landsat imagery

pEr BASEMENT ROCKS OF PRECAMBRIAN AGE—Granite and gneiss. The basement rocks are present in the core of the Black Hills and near Sioux Falls in southeastern South Dakota. There exposed in the Black Hills, these rocks are extensively dissected by canyons and narrow valleys formed along linear features. Therefore, in this area, the linear features are the most conspicuous of those shown on Landsat imagery in South Dakota. In contrast, near Sioux Falls, where the basement rocks are overlain by discontinuous glacial deposits, the linear features are not easily seen on Landsat imagery

CONTACT

SOUTHWESTERN LIMIT OF THE DISCONTINUOUS MANTLE OF GLACIAL AND GLACIOFLUVIAL DEPOSITS—These deposits mask many of the linear features that are present in the underlying sedimentary and igneous rocks

GENERALIZED DIRECTION OF STRIKE AND DIP OF THE TILTED SEDIMENTARY ROCKS ALONG THE FLANKS OF THE BLACK HILLS

LENGTH OF LINEAR FEATURES

- Less than 30 miles
- 30 to 200 miles
- 200 to 500 miles
- More than 500 miles

URBAN AREA DETERMINED FROM LANDSAT IMAGERY—Urban areas conceal the linear features

Base from U.S. Geological Survey
State base maps, 1:500,000

SCALE 1:500,000
0 20 40 60 MILES
0 20 40 60 KILOMETERS

Geology from N.H. Darton (1951); modified by M.E. Cooley, 1979