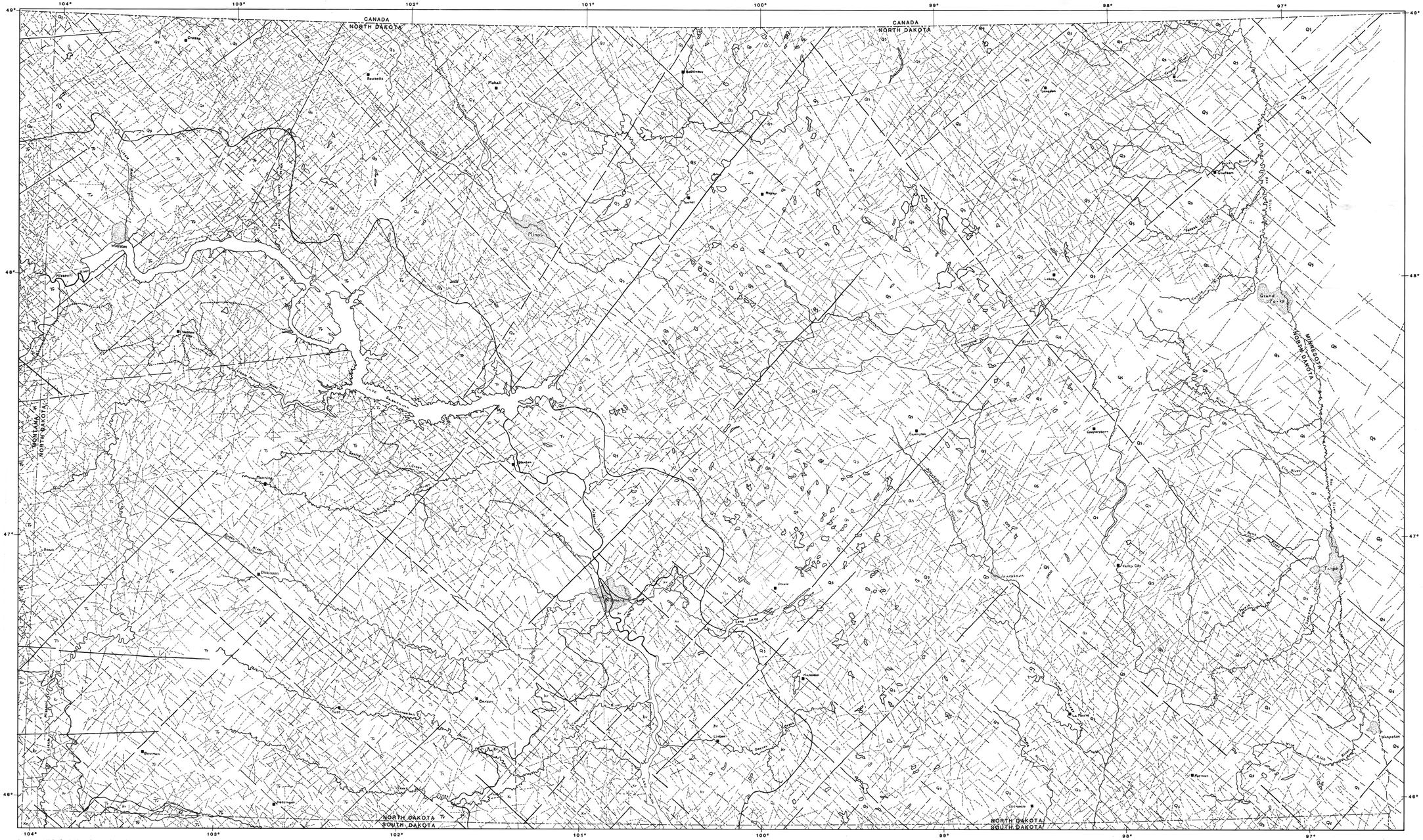
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

OPEN-FILE REPORT 83-937



Base from U.S. Geological Survey State base map, North Dakota, 1:500,000, 1963

Geologic contacts from Keefer (1974)

SCALE 1:500,000

0 20 40 60 MILES

0 20 40 60 KILOMETERS

LINEAR FEATURES DETERMINED FROM LANDSAT IMAGERY IN NORTH DAKOTA

By

Maurice E. Cooley

1983

IDENTIFICATION AND PLOTTING OF THE 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 North Dakota. Other maps in the series cover South Dakota (Cooley, 1983a), Wyoming (Cooley, 1983b), and Montana (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 North Dakota. The linear features shown on this map are not identified as type or origin, although most probably reflect fractures or fracture zones, including joints and faults. Fracture zones affect the movement of water or other fluids through the rocks.

The linear features were determined from visual inspection of color-infared 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. With one exception, all images have 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 observed on the imagery were used to identify the linear features. Physiographic features include straight segments of escarpments, ridges, and valleys, and dissected slopes, including some badlands. Vegetation growing on flood plains accentuates the configuration of shallow valleys. On plains and slopes that have slight surface relief, tonal contrasts in the color patterns of different vegetation and soils helped in the recognition or extension of some of the linear features.

In parts of the gentle plains of North Dakota, the linear features may be masked by widespread glacial-related deposits and by farming. The linearity shown by trends of the deposits forming glacial moraines tends to conceal many linear features present in the underlying sedimentary rocks. The rectangular pattern of cultivated fields and roads along section lines also makes it difficult to recognize linear features that trend due east or due north. Therefore, in formed, glaciated areas, there are fewer linear features plotted on the map--particularly those trending generally to the east or north--than are plotted in other parts of the state.

The linear features were plotted as dashed lines on transparent overlays on the Landsat images only in the 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 and upland areas, were usually the longest linear features.

The major and subordinate linear features were classified according to length into the four groups shown on the map. Determination of the length of the linear features that extend beyond North Dakota was aided by plotting the linear features from a mosaic of Landsat imagery of the United States (scale 1:5,000,000) compiled by the U.S. Soil Conservation Service (1974).

REFERENCES

Cooley, M. E., 1983a, Linear features determined from Landsat imagery in South Dakota and parts of adjacent states: U.S. Geological Survey Open-File Report 83-548, map, scale 1:500,000.

——— 1983b, Linear features determined from landsat imagery in Wyoming: U.S. Geological Survey Open-File Report 83-935, map, scale 1:500,000.

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

Keefer, W. R., 1974, Geologic map of the Northern Great Plains, in Regional topography, physiography, and geology of the Northern Great Plains: U.S. Geological Survey Open-File Report 74-50, plate A-3, scale 1:1,000,000.

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 79-34, 20 p.

U.S. Geological Survey and the American Association of Petroleum Geologists, 1961, Tectonic map of the United States, exclusive of Alaska and Hawaii: U.S. Geological Survey map, scale 1:2,500,000, 2 sheets.

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 1:5,000,000.

EXPLANATION

CORRELATION OF MAP UNITS

Qs	Quaternary	CENOZOIC
Tr	Tertiary	CENOZOIC
Kr	Cretaceous	MESOZOIC

DESCRIPTION OF MAP UNITS

Qs — UNCONSOLIDATED DEPOSITS OF QUATERNARY AGE--Clay to gravel. Deposits form an extensive mantle over much of North Dakota. They consist chiefly of glacial and glacial-related lacustrine and fluvial deposits. The Quaternary deposits mask many of the linear features that are present in the underlying sedimentary rocks, even though linear features were observed on the Landsat imagery throughout the area covered by these deposits. In parts of eastern North Dakota trends of moraines can be mistaken for linear features.

Tr — SEDIMENTARY ROCKS OF TERTIARY AGE--Shale and sandstone. Linear features in the Tertiary rocks are partly masked by generally slight differential erosion of the rocks, resulting from the low surface relief in the State, by discontinuous Quaternary deposits, and by widespread farming operations. Therefore, conspicuous linear features can be identified at only a few places on Landsat imagery.

Kr — SEDIMENTARY ROCKS OF CRETACEOUS AGE--Shale and sandstone. Linear features in the Cretaceous rocks are partly masked by generally slight differential erosion of the rocks, resulting from the low surface relief in the state, by discontinuous Quaternary deposits, and by widespread farming operations. Therefore, conspicuous linear features can be identified at only a few places on Landsat imagery.

——— CONTACT

····· SOUTHWEST LIMIT OF QUATERNARY GLACIAL DEPOSITS--Deposits form a discontinuous mantle on the sedimentary rocks. These deposits mask many of the linear features present in the underlying sedimentary rocks.

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