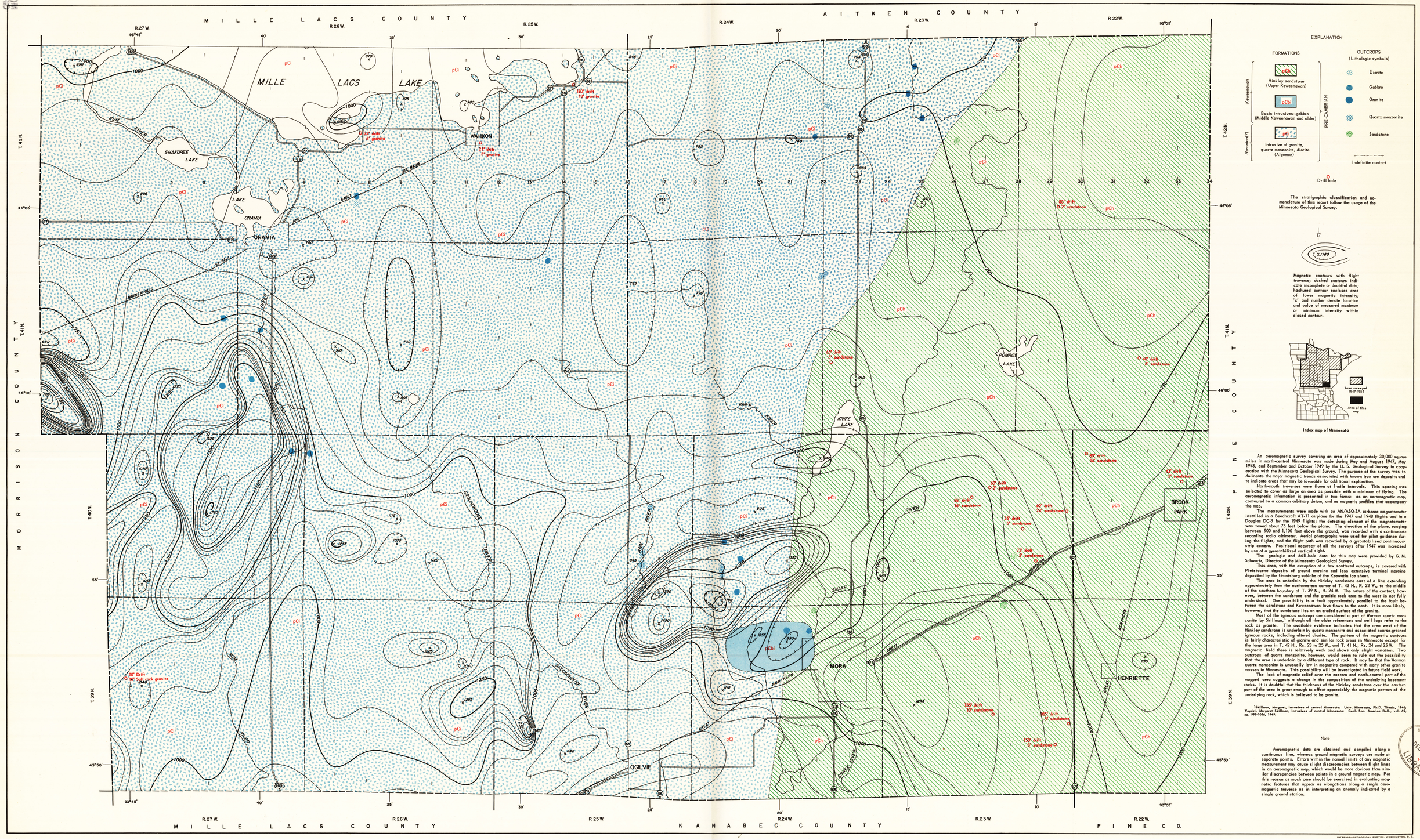
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH
THE MINNESOTA GEOLOGICAL SURVEY

GEOPHYSICAL INVESTIGATIONS
MAP GP 102




An aeromagnetic survey covering an area of approximately 30,000 square miles in north-central Minnesota was made during May and August 1947, May 1948, and September and October 1949 by the U. S. Geological Survey in cooperation with the Minnesota Geological Survey. The purpose of the survey was to delineate the major magnetic trends associated with known iron ore deposits and to indicate areas that may be favorable for additional exploration.

North-south traverses were flown at 1-mile intervals. This spacing was selected to cover as large an area as possible with a minimum of flying. The aeromagnetic information is presented in two forms: as an aeromagnetic map, contoured to a common arbitrary datum, and as magnetic profiles that accompany the map.

The measurements were made with an AN/ASQ-3A airborne magnetometer installed in a Beechcraft AT-11 airplane for the 1947 and 1948 flights and in a Douglas DC-3 for the 1949 flights; the detecting element of the magnetometer was towed about 75 feet below the plane. The elevation of the plane, ranging between 900 and 1,100 feet above the ground, was recorded with a continuous-recording radio altimeter. Aerial photographs were used for pilot guidance during the flights, and the flight path was recorded by a gyrostabilized continuous-strip camera. Positional accuracy of all the surveys after 1947 was increased by use of a gyrostabilized vertical sight.

The geologic and drill-hole data for this map were provided by G. M. Schwartz, Director of the Minnesota Geological Survey.

This area, with the exception of a few scattered outcrops, is covered with Pleistocene deposits of ground moraine and less extensive terminal moraine deposited by the Grantsburg sublobe of the Keewatin ice sheet.

The area is underlain by the Hinkley sandstone east of a line extending approximately from the northwestern corner of T. 42 N., R. 22 W., to the middle of the southern boundary of T. 39 N., R. 24 W. The nature of the contact, however, between the sandstone and the granitic rock area to the west is not fully understood. One possibility is a fault approximately parallel to the fault between the sandstone and Keweenawan lava flows to the east. It is more likely, however, that the sandstone lies on an eroded surface of the granite.

Most of the igneous outcrops are considered a part of Warman quartz monzonite by Skillman,[1] although all the older references and well logs refer to the rock as granite. The available evidence indicates that the area west of the Hinkley sandstone is underlain by quartz monzonite and associated coarse-grained igneous rocks, including altered diorite. The pattern of the magnetic contours is fairly characteristic of granite and similar rock areas in Minnesota except for the large area in T. 42 N., Rs. 23 to 25 W., and T. 41 N., Rs. 24 and 25 W. The magnetic field there is relatively weak and shows only slight variation. Two outcrops of quartz monzonite, however, would seem to rule out the possibility that the area is underlain by a different type of rock. It may be that the Warman quartz monzonite is unusually low in magnetite compared with many other granite masses in Minnesota. This possibility will be investigated in future field work.

The lack of magnetic relief over the eastern and north-central part of the mapped area suggests a change in the composition of the underlying basement rocks. It is doubtful that the thickness of the Hinkley sandstone over the eastern part of the area is great enough to affect appreciably the magnetic pattern of the underlying rock, which is believed to be granite.

[1]Skillman, Margaret, Intrusives of central Minnesota: Univ. Minnesota, Ph.D. Thesis, 1946; Wayda, Margaret Skillman, Intrusives of central Minnesota: Geol. Soc. America Bull., vol. 59, pp. 999-1016, 1949.

Note

Aeromagnetic data are obtained and compiled along a continuous line, whereas ground magnetic surveys are made at separate points. Errors within the normal limits of any magnetic measurement may cause slight discrepancies between flight lines in an aeromagnetic map, which would be more obvious than similar discrepancies between points in a ground magnetic map. For this reason as much care should be exercised in evaluating magnetic features that appear as elongations along a single aeromagnetic traverse as in interpreting an anomaly indicated by a single ground station.

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Base from Minnesota Department of Highways maps

# TOTAL INTENSITY AEROMAGNETIC AND GEOLOGIC MAP OF PARTS OF KANABEC, MILLE LACS, AND PINE COUNTIES, MINNESOTA

RELATIVE TO ARBITRARY DATUM

1 0 1 2 3 4 MILES

Contour interval 50 gammas
Flown 1000 feet above surface

1953

SHEET 1 OF 2

INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D. C.
Aeromagnetic survey 1948 by J. R. Henderson and J. L. Meuschke
Compilation directed by J. L. Meuschke

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Minnesota (Kanabec, Mille Lacs, and Pine Counties) Aeromagnetic map, 1953. Geol. Surv.