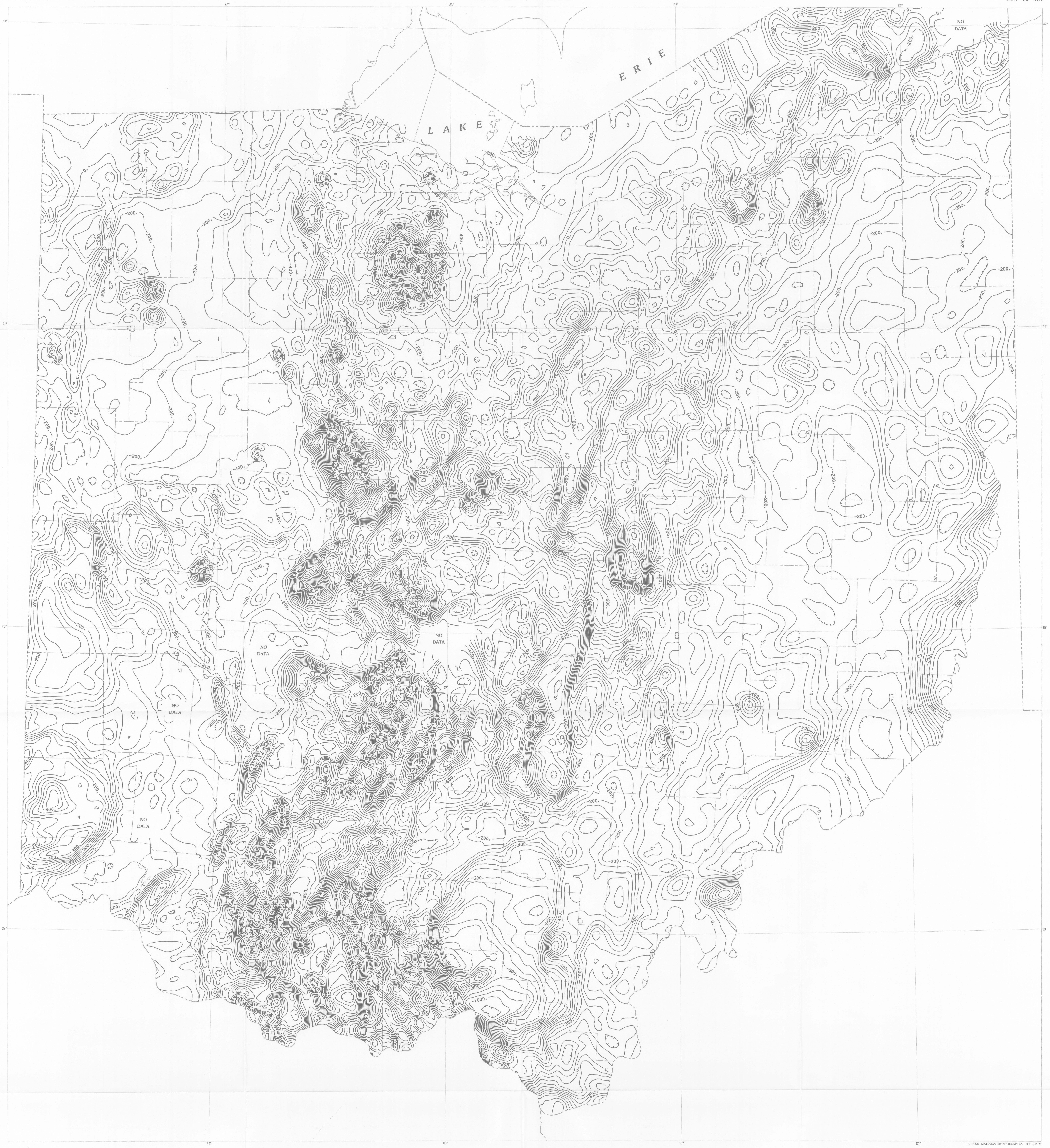

Base from U.S. Geological Survey, 1984

INTERIOR—GEOLOGICAL SURVEY, RESTON, VA.—1984—G84126

SCALE 1:500 000

10 0 10 20 30 40 50 MILES

10 0 10 20 30 40 50 60 70 KILOMETERS

Data were gridded at a spacing of 1 km on Lambert conformal conic projection 83° W as central meridian. Contours computer drawn

INTRODUCTION

The analysis of magnetic data often aids geologic investigations of the upper crust. In particular, Precambrian crystalline rocks and igneous rocks generally contain sufficient magnetic minerals to cause variations in the Earth's magnetic field. The predominant magnetic mineral in these rocks is magnetite. Sedimentary rocks, however, are generally non-magnetic and produce little or no change in the magnetic field. Thus a magnetic-anomaly map sees through the sedimentary-rock cover and conveys much information on lithologic contrasts and structural trends related to Precambrian crystalline basement and igneous bodies.

The magnetic-anomaly map compiled here provides a synoptic view of major anomalies and contributes to information concerning the tectonic development of Ohio. A geomagnetic reference field, that approximates the time-varying core and external-field components of the Earth's field, has been subtracted from the magnetic data. The resulting residual total-intensity map exhibits contour patterns related to crustal sources residing at depths shallower than the Curie point geotherm (the temperature above which rocks lose their magnetic properties).

The magnetic-anomaly map has been compiled from digital data. Although the digital data were obtained from aeromagnetic surveys that were made at different times, flight-line spacings, and elevations, we constructed a consistent data set by analytical continuation of the data onto a common surface of 1000 ft above ground. The availability of compatible digital data allows application of a variety of analytical techniques (Hildenbrand, unpublished data) that can be used to enhance anomalies and provide new interpretive information.

Data Reduction

The magnetic-anomaly map was compiled from digital data acquired from a diverse group of magnetic surveys (see index map). The magnetic coverage is comprised of airborne data except for the shipborne data collected on Lake Erie along tracks spaced 6 miles apart. The aeromagnetic surveys were flown with flight-line spacings ranging from 1 mi (1.6 km) to 2 mi (3.2 km) and in either a draped mode (constant elevation above terrain) or in a level mode (constant barometric altitude). Original flight-line data for recent surveys (A, C, D, and E on index map) were available on magnetic tape. For earlier surveys (B, F, and G), it was necessary to convert the data to digital form by digitizing the original, hand drawn, published contour maps.

For each individual aeromagnetic survey, the total-intensity data were gridded in units of decimal degrees at a grid interval of 0.0083 degrees (30") of latitude and longitude using a computer program (Webring, 1981) based on minimum curvature (Briggs, 1974). Lake Erie data were gridded at a coarser interval of 0.0167 degrees (1') of latitude and longitude. The geomagnetic reference fields appropriate for the date and location of the surveys were subtracted from the total-intensity grids to produce the residual total-intensity grids. The particular geomagnetic reference field removed depended on the year in which a given survey was carried out and included the International Geomagnetic Reference Field (1965) prior to 1965, the Provisional Geomagnetic Reference Field between 1975 and 1979, and the International Geomagnetic Reference Field (1980) after 1979 (Peddie, 1982a and b). The residual-anomaly grids were then projected to the Lambert conformal conic projection (standard parallels at 33°N and 45°N and central meridian of 83°W) and regridded to a 1-km grid.

To compile a consistent data set each survey was analytically continued to 1000 ft (305 m) above the ground, the selected datum surface. A Taylor's series expansion technique developed by Cordell and Grauch (1982) was used to drape the data onto this datum surface. Before merging, magnetic-field values of each survey were adjusted by a datum shift, if required, to minimize discontinuities at survey boundaries. The data sets were then merged using one-dimensional splining techniques described by Bhattacharyya and others (1979).

The overall precision of the anomaly values is difficult to estimate, mainly because of the diversity of surveys used to construct the map. Because of the wide spacing (6 mi) of ship tracks of the Lake Erie survey, expressions of the near-surface sources may be totally missed or misinterpreted due to lack of definition.

Another source of error occurs from surveys, especially old surveys, in which an arbitrary datum was removed from the magnetic-field values. Arbitrariness in datum level causes discontinuities at survey boundaries. These datum errors can be reduced or eliminated by adjusting the magnetic-field intensities by a constant amount to match intensities of a survey with a datum closely approximating the true or absolute datum level. Survey A, the southernmost survey (see index map), was recently flown at 1000 ft above ground. Because 1000 ft above ground is also the elevation to which the data on the final map were continued and because time and elevation of the survey were precisely known so that it was possible to remove an exact reference field, Survey A was used as a base to which all other survey-field values were adjusted and was, therefore, not adjusted itself. Errors may become progressively larger northward from Survey A but have been judged to be generally less than 50 gammas in regions where residual-field values from aeromagnetic surveys were referenced to a non-arbitrary datum level.

The last source of error requiring discussion involves the technique of draping surveys onto the surface 1000 ft above ground. We do not believe that these errors are appreciable considering the small range of surface elevations in Ohio (approximately 650 to 1550 ft).

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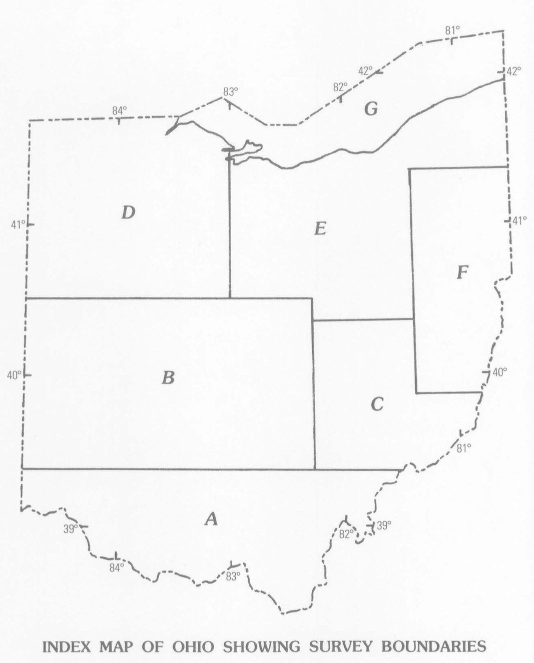
EXPLANATION

MAGNETIC CONTOURS

Contour interval 50 gammas. Hachured contours indicate closed areas of lower magnetic intensity



INDEX MAP OF OHIO SHOWING SURVEY BOUNDARIES

SURVEY SPECIFICATIONS

SURVEY	REFERENCE	LINE SPACING AND DIRECTION	ELEVATION (FT)
A	(USGS, 1983)	1.5 mi E-W	1000 Above Ground
B	(Harlan and others, 1979)	1.0 mi E-W	500 Above Ground
C	(USGS, 1980)	1.5 mi E-W	2000 Above Sea Level
D	(USGS, 1982)	1.5 mi E-W	1800 Above Sea Level
E	(USGS, 1982)	2.0 mi E-W	1800 Above Sea Level
F	(Popenoe and others, 1964)	1.0 mi N-S	500 Above Ground
G	(Peter and others, 1961)	5.0 mi Varied	Surface of Lake Erie

SOURCES OF DATA

B Harlan, J. B., Simpson, R. W., and Kane, M. F., 1979, Digitized aeromagnetic map of the Columbus-Dayton area, Ohio and Indiana, U.S. Geological Survey Open-File Report No. 79–928, scale 1:250,000.

G Peter, G., and Wall, R. E., 1961, Magnetic total intensity measurements on Lake Erie, Technical Report No. 1, CU-2-61-Nohr-Geology.

F Popenoe, Peter, Petty, A. J., and Tyson, N. S., 1964, Aeromagnetic map of western Pennsylvania and parts of eastern Ohio, northern West Virginia, and western Maryland, U.S. Geological Survey Geophysical Investigations Map GP–445, scale 1:250,000.

C U.S. Geological Survey, 1980, Aeromagnetic map of southeastern Ohio, U.S. Geological Survey Open-File Report No. 80–615, scale 1:250,000.

D,E U.S. Geological Survey, 1982, Aeromagnetic map of northern Ohio, U.S. Geological Survey Open-File Report No. 82–191, scale 1:250,000.

A U.S. Geological Survey, 1983, Aeromagnetic map of southern Ohio, U.S. Geological Survey Open-File Report No. 83–59, scale 1:250,000.

RESIDUAL TOTAL INTENSITY MAGNETIC MAP OF OHIO

By
T. G. Hildenbrand and R. P. Kucks

1984

For sale by Branch of Distribution, U.S. Geological Survey, 1200 South Eads Street, Arlington, VA 22202