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ILLINOIS STATE GEOLOGICAL SURVEY

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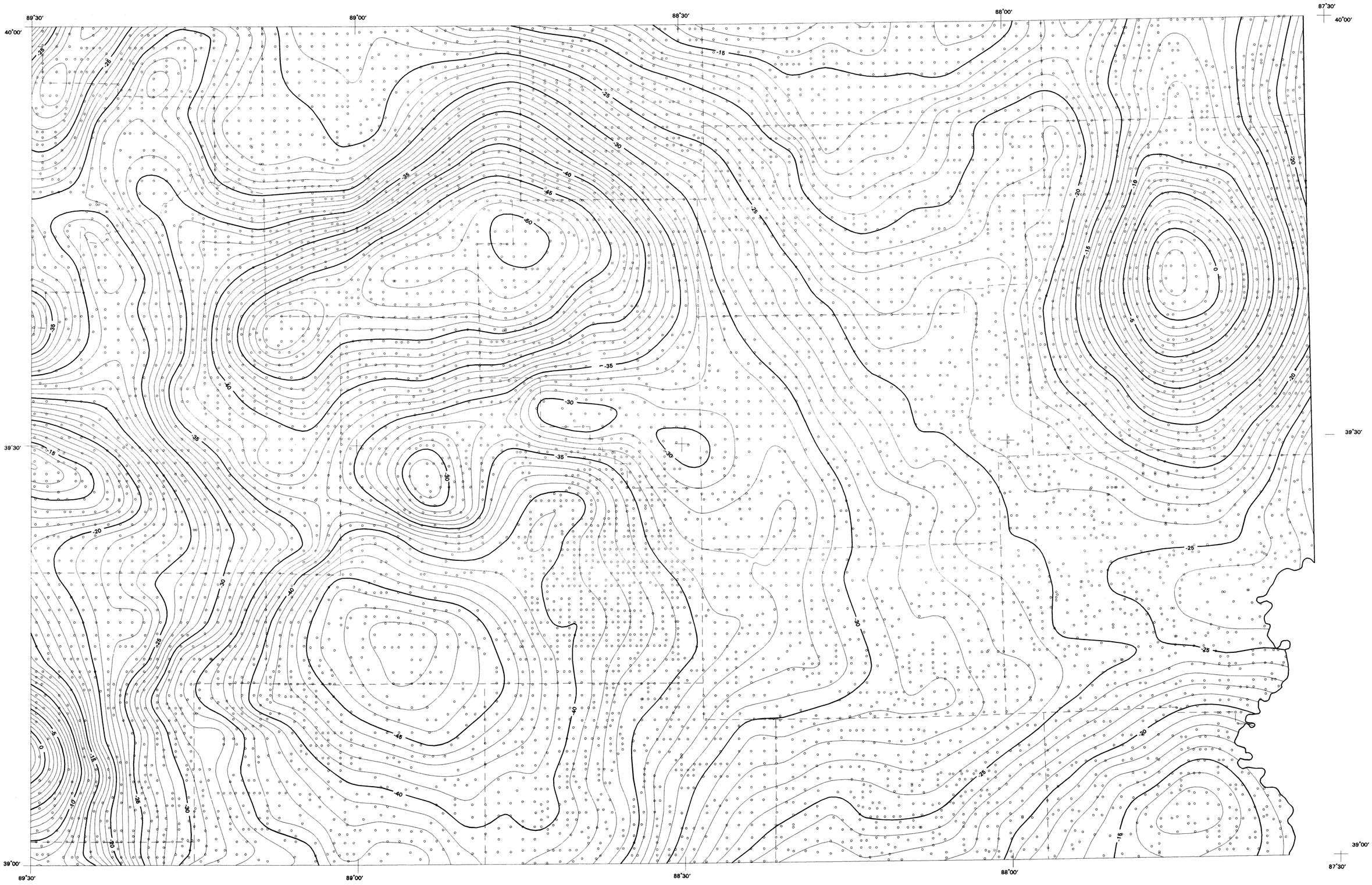
Argonne National Laboratory, and Northern Illinois University



SIMPLE BOUGUER GRAVITY ANOMALY MAP OF SOUTHEAST-CENTRAL ILLINOIS

Latitude 39° to 40° Longitude 89°30′ to east border

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Scale 1:250,000

5 0 5 10 15 miles

5 0 5 10 15 20 kilometers

Lambert conformal conic projection 33°N and 45°N, central meridian 93°W

Contour interval 1 mgal
Bouguer correction density 2.67 g/cc

Simple Bouguer Gravity Anomaly Maps of Illinois

The gravitational field of the earth consists of two types of forces: the attracting forces between bodies (Newton's law), and the centrifugal forces due to the earth's rotation. The earth's rotation produces its general shape (oblate spheroid, flattened at the poles). Part of the variation in the attracting forces is due to lateral changes in density related to geologic structures and lithologic changes, the main foci of the exploration geophysicist.

The observed value of gravity thus depends upon latitude, elevation, topography, and tidal movements as well as lateral changes in density. Because only lateral changes in density are geologically significant, corrections must be made to the observed gravity to eliminate the effects of the other factors.

The effects caused by the rotation and nonspherical shape of the earth can be removed from the observed gravity by using a formula for the gravitational forces on the surface of an idealized reference model of the earth. The free air and the simple Bouguer corrections are applied to refer the observed gravity values to a common datum (usually mean sea level). The free air correction accounts for the normal decrease in the gravitational field with increasing elevation; whereas the Bouguer correction eliminates the effect of the mass between the observation point and the datum. The portion of the observed gravity that remains after all these corrections is known as the simple Bouguer gravity anomaly.

Data Reduction

Observed gravity, elevation, latitude, and longitude were recorded at 49,856 stations throughout the state. Average distance between gravity stations is approximately 1.6 km (1 mi).

All observed gravity values were tied to the International Gravity Standardization Network of 1971 (Morelli et al. 1974) and corrected for latitude variation on the reference ellipsoid by using the 1967 Gravity Formula (International Association of Geodesy 1967). The Bouguer correction was computed using a density of 2.67 g/cc. The procedures for computing these values are described in detail by Cordell et al. (1982).

These data were gathered over approximately 15 years for the purpose of establishing a regional background field. The data may not be sufficiently accurate for some of the more sensitive mathematical transformations employed in modern analysis. No terrain corrections have been applied to the data.

Station elevations, obtained from 7.5- and 15-minute topographic maps, are accurate to the nearest foot. In a few cases, cultural activities may have altered the elevation of a given gravity station after the topographic map was published, but before the gravity survey was made. An error of 1 foot in elevation at a given station would result in an error of 0.05998 mgal in the Bouguer gravity anomaly value for that station.

A grid (interval 1.5 km) of Bouguer gravity anomaly values was derived from the irregularly spaced data by means of a computer program (Webring 1982) based on minimum curvature (Briggs 1974). For smoother contours, these data were further interpolated to a finer grid of data (interval 0.75 km) by means of the Godson and Webring program (1982).

Acknowledgments

The nine simple Bouguer gravity anomaly maps of Illinois were produced from data gathered and processed by members of the Illinois State Geological Survey (ISGS) and Northern Illinois University. After the data were further processed, plotted, and contoured by members of the U.S. Geological Survey, final maps were generated at the ISGS. Reproduction and distribution of the maps were also the responsibilities of the ISGS.

References

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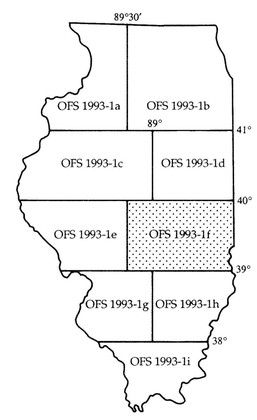

The nine 1:250,000-scale maps presenting the simple Bouguer gravity anomaly of Illinois are available as Open File Series 1993-1a through 1993-1i. The 1:500,000-scale, statewide map has been published as ISGS Illinois Map 1.

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