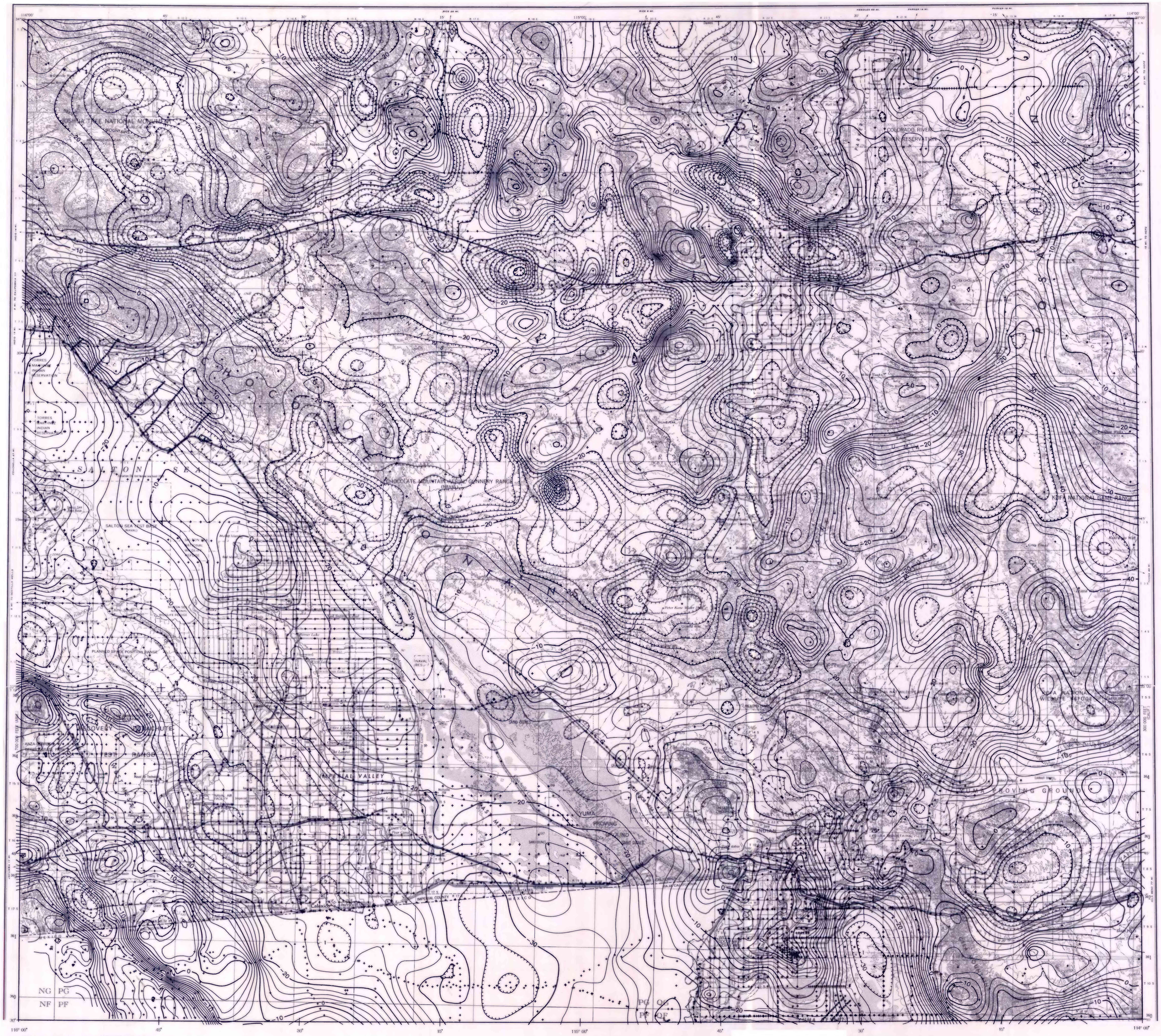
OPEN-FILE REPORT

86-347

SHEET 3 OF 7



BASE MAP FROM U.S. GEOLOGICAL SURVEY TOPOGRAPHIC SERIES 1:250,000
SALTON SEA 1959, EL CENTRO 1958

LOCATION DIAGRAM

SCALE 1:250 000

5 0 5 10 15 20 MILES

5 0 5 10 15 20 25 30 KILOMETERS

CONTOUR INTERVAL 200 FEET

TRANSVERSE MERCATOR PROJECTION

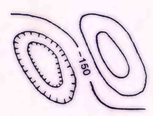
BOUGUER AND ISOSTATIC RESIDUAL GRAVITY MAPS OF THE COLORADO RIVER REGION, INCLUDING THE KINGMAN, NEEDLES, SALTON SEA, AND EL CENTRO QUADRANGLES

SALTON SEA AND EL CENTRO ISOSTATIC RESIDUAL GRAVITY MAP

by
John Mariano, M. G. Helferty, and T. B. Gage

1986

This map is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards



Gravity Anomaly Contours

Contour interval is 5 mGal. Hachured contours indicate closed gravity lows.

Explanation

The principal gravity data set compiled for this map was generated by various projects of the U.S. Geological Survey. This set was then supplemented with data received from the Defense Mapping Agency Gravity Library. The observed gravity data, based on the International Gravity Standardization Net (IGSN71) datum (Morelli, 1974), were reduced to free air gravity anomalies by using the Geodetic Reference System 1967 formula (GRS67) for the theoretical value of gravity at sea level (International Association of Geodesy, 1971, p. 60) and Swick's (1942, p. 65) formula for the free air correction. Bouguer, curvature, and terrain corrections (out to a distance of 166.7 km from the station) at a standard reduction density of 2.67 g/cm^3 were added to the free-air anomaly at each station to determine complete Bouguer gravity anomalies.

Editing of data involved examination and subsequent deletion of stations which produced large anomalies not supported by values at neighboring stations. This procedure probably was successful in eliminating gross errors in areas with dense gravity coverage but incorrect values may still exist in areas of sparse coverage.

The bulk of the inconsistencies remaining within this data set probably stem from observed gravity values based on a datum other than IGSN71 and from errors in terrain corrections. Because the gravity data came from a variety of different sources, some datum problems were unavoidable. However, based on comparisons of redundant observations from different sources, datum inconsistencies are believed to be less than 1 mGal. Terrain corrections (within .895 km of the site of observation) were applied by hand only to some of the U.S. Geological Survey data and generated by computer for the rest of the data set. The error introduced at this stage probably is less than 1 mGal for most stations but could be larger for stations in areas of extreme topographic relief. In view of these problems, the data are believed, in general, to be accurate to within 2 mGals.

The Bouguer gravity field over the western United States reflects both shallow crustal density variations and deep-seated density distributions, many of which are directly related to isostatic support of topography (Simpson and others, 1985). In an attempt to emphasize the gravity anomalies caused by shallow density distributions (those most readily correlated with the results of geologic mapping) the isostatic residual gravity map was constructed from the Bouguer gravity data by removing a regional gravity field based on a simplified model for isostatic compensation of topography. Extensive tests on similar maps from California (Jachens and Griscom, 1985) and the conterminous United States (Simpson and others, 1985) indicate that anomalies on isostatic residual gravity maps primarily reflect lateral density variations in the mid- to upper-crust.

Isostatic corrections were calculated assuming complete local compensation according to the Airy-Heiskanen system. Calculations were performed by computer (Jachens and Roberts, 1981) out to a radius of 166.7 km from each station using formulas of Heiskanen and Vening Meinesz (1958, p. 136 and 182) modified to incorporate station elevations. Thickness of the model crust was calculated from topography averaged over 3 x 3 minute compartments (Robbins and others, 1973) assuming density of topography, 2.67 g/cm^3, sea-level crustal thickness, 25 km, and density contrast across the base of the model crust, 0.40 g/cm^3. For the region beyond 166.7 km, combined terrain and isostatic corrections were taken from published topographic-isostatic reduction maps (Karki and others, 1961).

Contouring by computer with 1000 meter grid size.

References

Heiskanen, W. A., and Vening Meinesz, F. A., 1958, The earth and its gravity field: McGraw-Hill Book Co., Inc., New York, 470 p.

International Association of Geodesy, 1971, Geodetic reference system 1967: International Association of Geodesy Special Publication no. 3, 116 p.

Jachens, R. C., and Griscom, Andrew, 1985, An isostatic residual gravity map of California--A residual map for interpretation of anomalies from intracrustal sources, in Hinze, W. J., (ed.) The utility of regional gravity and magnetic anomaly maps: Society of Exploration Geophysicists, Tulsa, p. 347-360.

Jachens, R. C., and Roberts, C. W., 1981, Documentation of a FORTRAN program 'isocomp' for computing isostatic residual gravity: U.S. Geological Survey, Open-File Report 81-574,--p. 26.

Karki, P., Kivioja, L., and Heiskanen, W. A., 1961, Topographic-isostatic reduction maps for the world for the Hayford zones 18-1, Airy-Heiskanen system, T=30 km: Isostatic Institute of the International Association of Geodesy, no. 35, 5 p., 20 maps.

Morelli, C., (Ed.), 1974, The International gravity standardization net 1971: International Association of Geodesy Special Publication no. 4, 194 p.

Robbins, S. L., Oliver, H. W., and Plouff, Donald, 1973, Magnetic tape containing average elevations of topography in California and adjacent regions for areas of 1 x 1 minute and 3 x 3 minutes in size: U.S. Geological Survey Report, 31 p., tape, available from National Technical Information Service, U.S. Department of Commerce, Springfield, VA, NTIS-PB 219794.

Simpson, R. W., Jachens, R. C., Saltus, R. W., and Blakely, R. J., 1985, A new isostatic residual gravity map of the conterminous United States (abs.): Expanded abstracts with biographies, 55th annual international meeting and exposition, Society of Exploration Geophysicists, p. 197-198.

Swick, C. H., 1942, Pendulum gravity measurements and isostatic reductions: U.S. Coast and Geodetic Survey Special Publication no. 232, 518 p.

Data Sources

1. Snyder, D. G., Roberts, C. W., Saltus, R. W., and Sikora, R. F., 1982, A magnetic tape containing the principal facts of 64,026 gravity stations in the state of California: U.S. Geological Survey NTIS PB-82-168287 (available from U.S. Department of Commerce, National Technical Information Service, Springfield, VA 22152.
2. Gage, T. B., and Simpson, R. W., 1981, Principal facts for gravity stations in the Big Maria, Riverside, and Whipple Mountains, California: U.S. Geological Survey Open-File Report 81-30,--p. 22.
3. Gage, T. B., and Simpson, R. W., 1982, Principal facts for gravity stations in and near the Whipple Mountains Wilderness Study Area (CDCA-312), San Bernardino County, California and Mohave County, Arizona: U.S. Geological Survey Open-File Report 82-1089, 22 p.
4. Bracken, R. E., and Simpson, R. W., 1982, Principal facts for gravity stations in the Sheep Hole/Cadiz Wilderness Study Area (CDCA-355), California: U.S. Geological Survey Open-File Report 82-882, 30 p.
5. Defense Mapping Agency, 1985, Gravity data obtained from DMA file on Nov. 26, 1985: David H. Alspaugh, Asst. Chief, Geopositional Dept.
6. U.S. Geological Survey, 1982-1985, Unpublished gravity data in the Kingman, Needles, and Salton Sea quadrangles collected by M. G. Helferty, R. C. Jachens, R. L. Morin, and R. W. Simpson.
7. Helferty, M. G., and Erdman, C. F., 1985, Principal facts for 113 Gravity Stations in the Salton Sea 1 by 2 Degrees Quadrangle, Southern California: U.S. Geological Survey Open-File Report 85-527, p 13.
8. Bracken, R. E., and Kane, M. F., 1982, Bouger gravity map of the Nevada portion of the Kingman 1° x 2° quadrangle: U.S. Geological Survey Open-File Report 82-388,--p. 1.
9. Gage, T. B., 1985, Gravity and Magnetic Analysis of the CALCREST Study Area, San Bernardino County, California: Los Angeles, Calif., University of Southern California, M.S. Thesis, (in process).