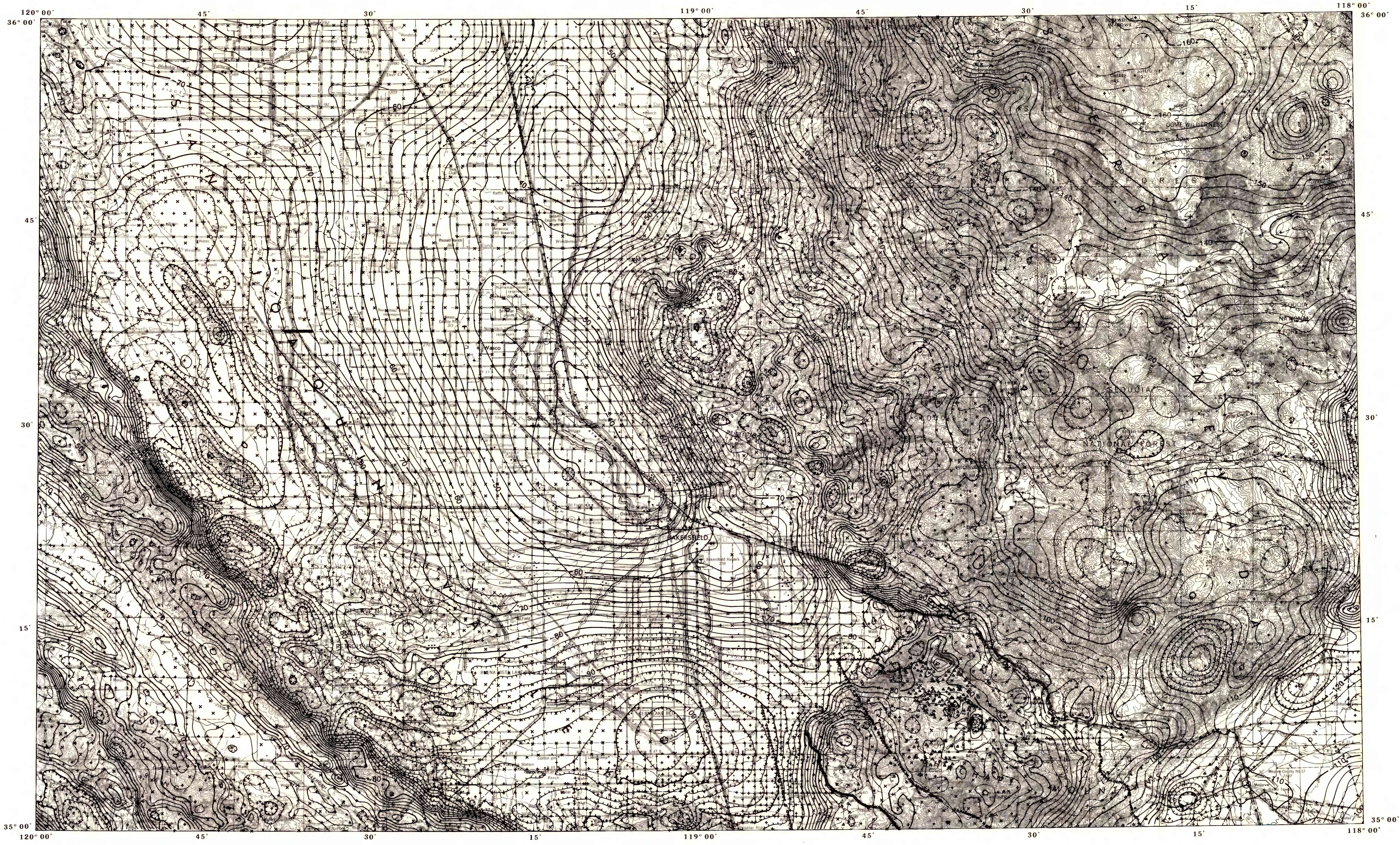
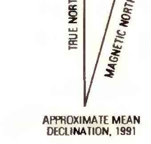
OPEN-FILE REPORT
91-554

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

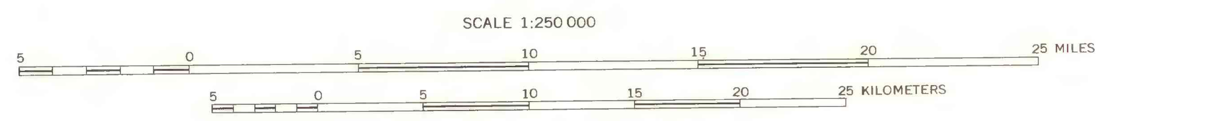


Topographic base from U.S. Geological Survey
Bakersfield (1962; revised 1968) at 1:250,000
Universal Transverse Mercator projection

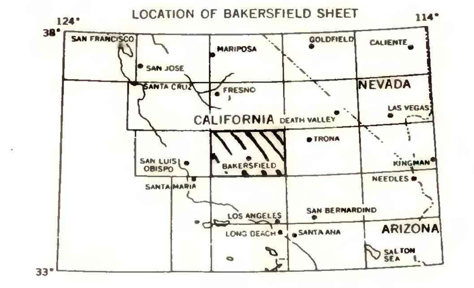


APPROXIMATE MEAN DECLINATION, 1991

SCALE 1:250 000



Contour interval of base 200 feet
with supplementary contours at 100 ft intervals



COMPLETE BOUGUER GRAVITY ANOMALY AND ISOSTATIC RESIDUAL GRAVITY MAPS OF THE BAKERSFIELD 1° BY 2° QUADRANGLE, CALIFORNIA

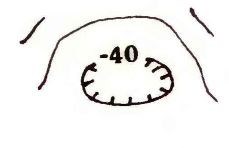
COMPLETE BOUGUER GRAVITY ANOMALY MAP

By

V.E. Langenheim and J.B. Plescia

1991

EXPLANATION



Gravity anomaly contours. Contour interval 2 mGal. Hachures indicate gravity low. Contours were computer generated based on a 800-meter grid derived from scattered gravity data. Although the data have been edited, caution should be exercised when interpreting anomalies controlled by only a single gravity station.

✛ Gravity station collected by USGS (see Langenheim and Plescia, 1991).

× Gravity station obtained from Defense Mapping Agency.

△ Gravity station obtained from unpublished thesis by Plescia (1985).

DATA SOURCES, REDUCTIONS, AND ACCURACIES

Gravity data in the Bakersfield 1:250,000 scale quadrangle and vicinity were obtained from Snyder and others (1982) and supplemented by 2,919 gravity stations from the Defense Mapping Agency (written commun., 1982), 729 gravity stations collected by J.B. Plescia (1985), and 60 previously unpublished U.S. Geological Survey stations. These data are mostly located in western two-thirds of the quadrangle. The datum of observed gravity for this map is the International Gravity Standardization Net of 1971 (IGSN 71) as described by Morelli (1974); the reference ellipsoid used is the Geodetic Reference System 1967 (GRS67; International Association of Geodesy, 1971). The datum of observed gravity used for the previously published map of the Bakersfield quadrangle (Hanna and others, 1975) was that of Woollard and Rose (1963); those data were reduced using the International Gravity Formula of 1930 (Swick, 1942, p. 61).

A constant of -14.47 mGal, the difference in observed gravity between the IGSN 71 and Woollard and Rose (1963) datums measured at IGSN 71 base station MPA (Menlo Park, Calif.) to which all the gravity data were tied, was added to the observed gravity of all data from Snyder and others (1982). These data then were re-reduced using the GRS67 ellipsoid formula. The complete Bouguer anomaly values on the Hanna and others (1975) map are on average 2.2 mGal higher than the values on this map, resulting from the combined change in datum and use of the ellipsoid formula. Base station ties established in September, 1990, show that no large datum shift (greater than 0.4 mGal) exists between the various sources of data that would significantly affect the use of this integrated data set for studies at the scale of this map (Langenheim and Plescia, 1991).

The observed gravity data, based on the International Standardization Net Datum (Morelli, 1974) were reduced to free-air anomalies using standard formulas (see Oliver, 1980, p. 52). Bouguer, curvature, and terrain corrections to distances of 166.7 km (Godson and Plouff, 1988) were applied to the free-air anomaly at each station to determine the complete Bouguer anomalies at a standard reduction density of 2.67 g/cm^3 (Plouff, 1977).

Accuracies for the gravity data are listed in Langenheim and Plescia (1991) which gives an accuracy code for each gravity measurement. The main sources of error are inaccurate elevations and limitations of the terrain correction. Errors associated with terrain corrections are considered to be 5 to 10 percent of the value of the total terrain correction. The average error based on the average terrain correction (3.00 mGal) is 0.3 mGal, but in the most rugged areas of the Sierra Nevada and Tehachapi Mountains, the errors may be as high as 4 mGal. Errors resulting from inaccuracies in elevation are probably less than 0.5 mGal for most of the data because the majority of the stations are near bench marks and spot and surveyed elevations, which are accurate to about 0.2 to 3 m. Measurements for which elevations were controlled by contour interpolation are expected to have errors of up to 2.4 mGal. Most of the Defense Mapping Agency stations are located in the San Joaquin Valley with terrain corrections less than 1 mGal and surveyed elevations. In general, the accuracy for the most of the data shown in the map is estimated to be better than 2 mGal (or one contour).

DISCUSSION

The Bouguer gravity field over the Bakersfield 1° by 2° sheet reflects not only density variations related to upper crustal lithology and geologic structure, but also deep crustal and upper mantle density distributions that support topography (Oliver, 1980). The gradient of the Bouguer gravity field between the San Joaquin Valley and the Sierra Nevada is mostly caused by the negative gravitational effect of the Sierra Nevada root as evidenced by the average complete Bouguer anomaly value of -81 ± 24 mGal. This gradient masks subtler anomalies associated with near-surface geology.

Previous authors have discussed the relation between gravity and geology for the Bakersfield quadrangle, primarily in qualitative terms, but supported in some instances with gravity models. In particular, Plescia (1985) modelled the gravity field of the Tehachapi Mountains in order to determine crustal thickness and structure. Hanna and others (1975) described the major gravity anomalies of the Bakersfield quadrangle in the context of geologic and other geophysical data. General discussions of the gravity field over the Great Valley, Sierra Nevada, and Mojave Desert may be found in Oliver (1980).

Additional data from the Defense Mapping Agency and Plescia stations greatly enhances the station coverage of the western two-thirds of the Bakersfield sheet. Although no new gravity anomalies are recognized as a result of this increased coverage at the scale of this map, the shape and location of known anomalies did change somewhat. For example, the gravity high extending from Monotti Creek south to Mt. Adelaide, about 25 km northeast of Bakersfield is more pronounced and is shifted to the east by about 2 km with respect to the anomaly shown by Hanna and others (1975). The gravity high over the western Tehachapi Mountains west of Cummings Valley now contains shorter-wavelength features constrained by the new data.

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