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

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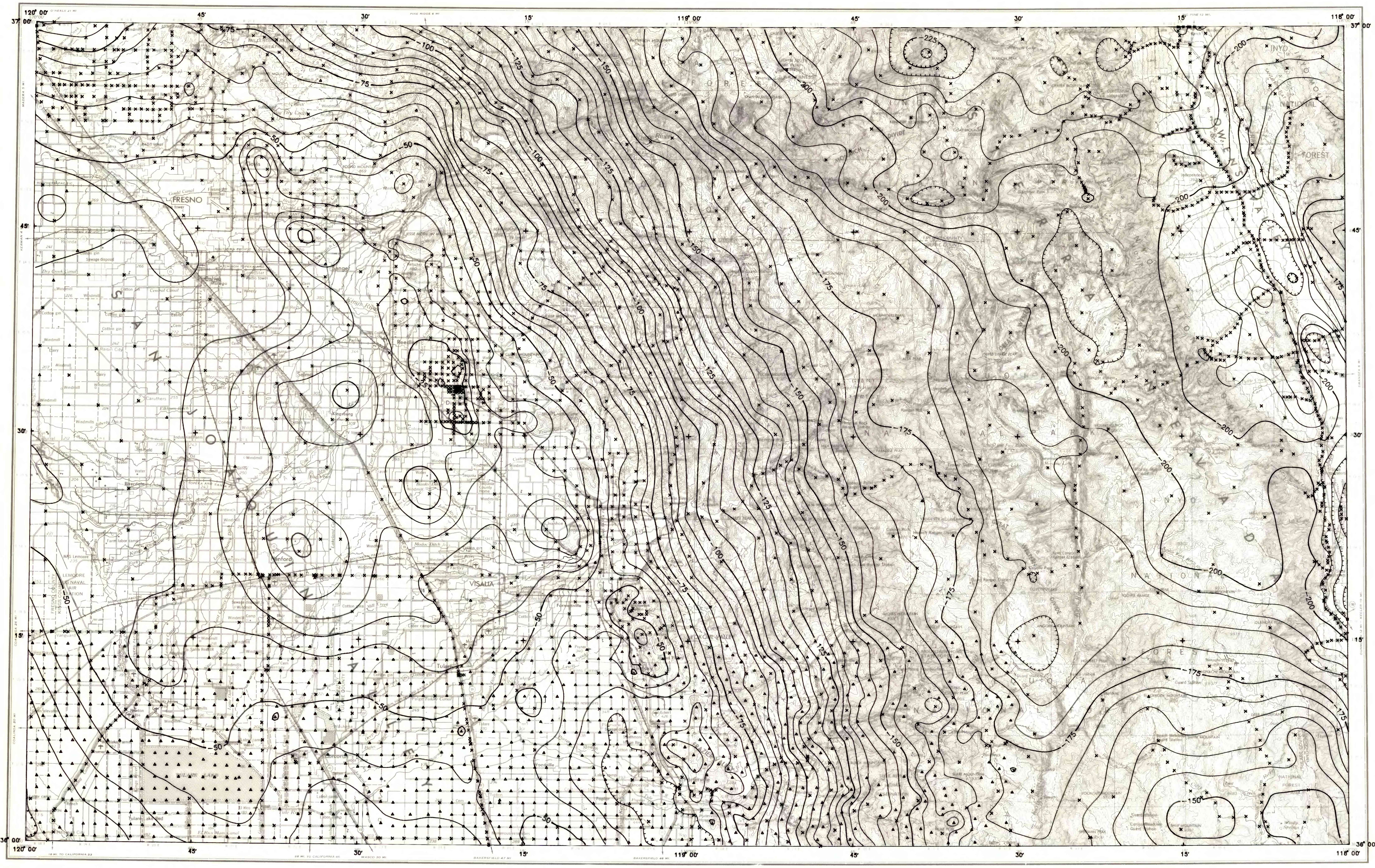
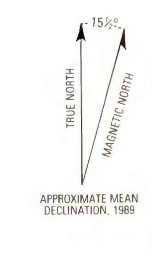
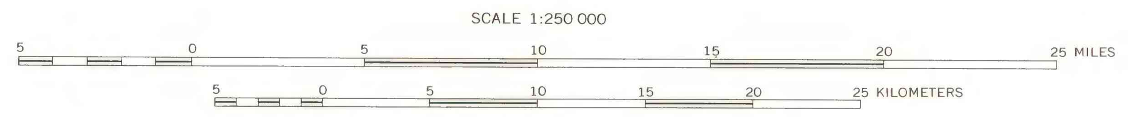
91-106
SHEET 1 OF 2

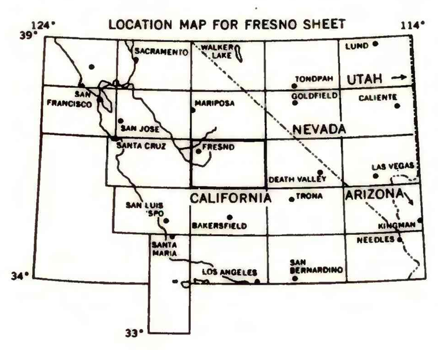


Base from U.S. Geological Survey
Fresno (1962, revised 1971) at 1:250,000
Universal Transverse Mercator projection





Contour interval of base 200 ft.



COMPLETE BOUGUER GRAVITY ANOMALY AND ISOSTATIC GRAVITY MAPS OF THE FRESNO 1° x 2° QUADRANGLE, CALIFORNIA

COMPLETE BOUGUER GRAVITY ANOMALY MAP

By

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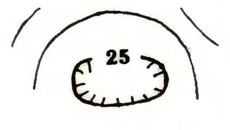
1991

EXPLANATION



Gravity anomaly contours. Contour interval 5 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 (see Robbins and others, 1975).

▲ Gravity station obtained from Defense Mapping Agency.

DATA SOURCES, REDUCTIONS, AND ACCURACIES

Gravity data in the Fresno 1:250,000 scale quadrangle and vicinity were obtained from Robbins and others (1975) and supplemented by 1,030 gravity stations from the Defense Mapping Agency (written commun., 1982), mostly located in the southwestern part of the quadrangle in the San Joaquin Valley. 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 used for the previously published map (Oliver and Robbins, 1982) was that of Woollard and Rose (1963); the 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 two 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 Robbins and others (1975). These data were re-reduced using the GRS67 ellipsoid formula. The complete Bouguer anomaly values on the Oliver and Robbins (1982) map are on average 2.2 mGal higher than the values on this map, resulting from the change in datum and ellipsoid formula. Base station ties carried out in September, 1990, show that no large datum shift (greater than 0.3 mGal) between the two sets of data exists that would significantly affect the use of this integrated data set for studies at the scale of this map (Kirchoff-Stein and Langenheim, 1990).

The observed gravity data, based on the International Standardization Net Datum (Morelli, 1974) were reduced to free-air anomalies using standard formulas (e.g. Telford and others, 1976). Bouguer, curvature, and terrain corrections (to a distance of 166.7 km; Plouff, 1977) 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 in Kirchoff-Stein and Langenheim (1990) which gives an accuracy code for each gravity measurement. The main sources of error are inaccurate elevations and limitation 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 (5.37 mGal) is 0.5 mGal, but in the most rugged areas of the Sierra Nevada and Inyo Mountains, the errors may be as high as 7 mGal. Errors resulting from elevation control are probably less than 0.5 mGal for most of the data because the majority of the stations are at or 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 would be 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 total uncertainties for the data shown in the map are estimated to be less than 5 mGal (or one contour).

DISCUSSION

The Bouguer gravity field over the Fresno 1:250,000 quadrangle reflects not only density variations related to upper crustal lithology and geologic structure, but also deep crustal and upper mantle density distributions that support isostasy (Oliver, 1980). The large gradient in the Bouguer gravity field between the San Joaquin Valley and the Sierra Nevada results from the large negative gravitational effect of the Sierra Nevada root as evidenced by the average complete Bouguer anomaly value of -96.5 ± 63.4 mGal. This gradient masks the more subtle anomalies associated with near-surface geology.

Previous authors have discussed the relation between gravity and geology for the Fresno quadrangle, primarily in qualitative terms, but supported in some instances with gravity models. In particular, Saleeby (1975) modelled the gravity field of the Kings-Kaweah ophiolite belt. Oliver and Robbins (1982) not only revised this gravity model with additional data, but also presented a comprehensive discussion of the Fresno sheet, describing the major anomalies on the Fresno sheet in the context of geologic and other geophysical data. They also presented a crustal model determining the regional effect of isostasy on the Bouguer field along an east-west profile. General discussions of the gravity field over the Great Valley, Sierra Nevada, and Basin and Range may be found in Oliver (1980).

Addition of the Defense Mapping Agency stations greatly enhances the station coverage of the southwestern portion of the Fresno sheet on sedimentary rocks in the San Joaquin Valley, but does not greatly change the overall shape of the anomalies in this part of the quadrangle.

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