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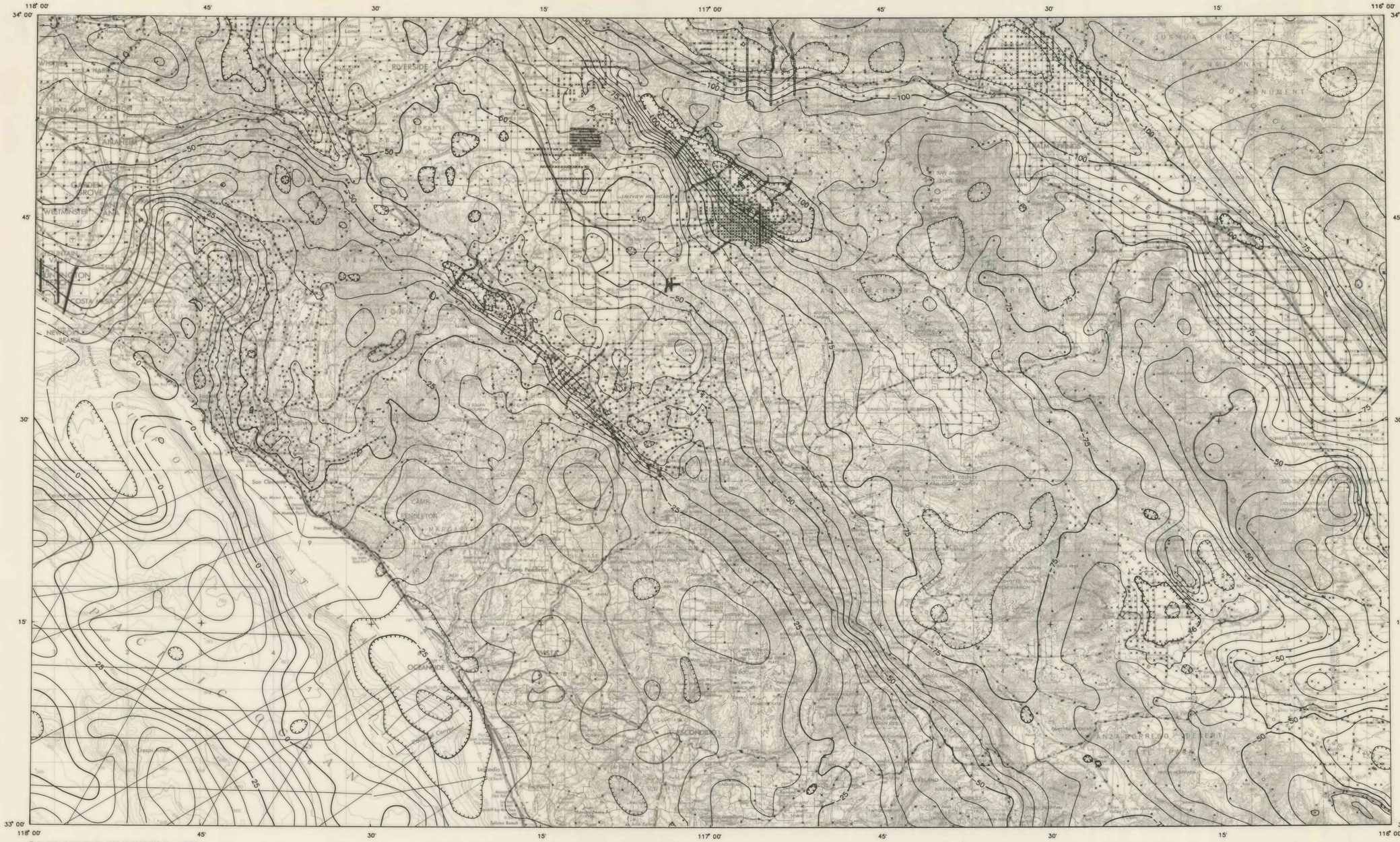
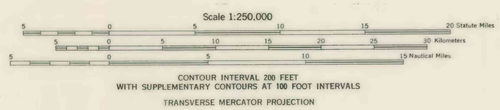
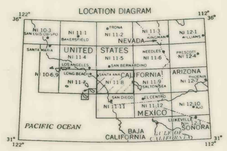


Base map prepared by the U.S. Geological Survey and the National Ocean Survey 1959 (revised 1979) at 1:250,000. Universal Transverse Mercator projection





COMPLETE BOUGUER GRAVITY ANOMALY MAP OF THE SANTA ANA 1° BY 2° QUADRANGLE, CALIFORNIA

By

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EXPLANATION

Gravity anomaly contours. Contour interval 5 mGal. Hachures indicate gravity low. Contours were computer generated based on an 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 STATIONS

- \+ U.S. Geological Survey (U.S.G.S.)
- x Shawn Biehler
- Δ Defense Mapping Agency (D.M.A.)
- ∇ California Division of Mines and Geology (CDMG)
- ◇ A.G. Hull
- □ E.L. Blanck, Jr.
- ○ W.R. Moyle and D.J. Downing

DATA SOURCES, REDUCTIONS, AND ACCURACIES

Land gravity data in the Santa Ana 1° by 2° quadrangle include 5077 gravity stations collected by S. Biehler and students at University of California, Riverside, supplemented by 197 gravity stations collected by A.G. Hull (written commun., 1991), 479 gravity stations collected by W.R. Moyle and D.J. Downing (A.G. Hull, written commun., 1991), 354 gravity stations from the Defense Mapping Agency (written commun., 1982), 533 gravity stations collected by the California Division of Mines and Geology, 162 stations from E.L. Blanck, Jr. (1987), and 384 stations collected by the U.S. Geological Survey . The datum of observed gravity for this map is that of Woollard and Rose (1063); the data were reduced using the 1930 International Gravity formula (Swick, 1942, p. 61) to maintain compatibility with the published Bouguer gravity map of the state of California (Oliver and others, 1980). The observed gravity data 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). For more detail on the base stations, data sources and reduction process, see Sikora and others (1992).

Marine gravity measurements were made by shipboard gravity meters during the 1970 cruise of the Surveyor (NOAA-NAVOCEANO), 1973 cruise of the G.B. Keles (USGS), and 1974 cruise of the S.P. Lee (USGS). Gravity values were converted to absolute values by tying harbor base stations to the 1963 datum of Woollard and Rose (1963). Vedder and others (1974) hand contoured free-air gravity values based on the 1930 International Gravity formula (Swick, 1942) and digitized the resulting map on a 2-minute grid from which the complete Bouguer gravity anomaly values were calculated.

Principal sources of error in land gravity data are inaccurate elevations and/or inaccurate terrain corrections. 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 (2.35 mGal) is about 0.1 to 0.2 mGal, but in the most rugged areas of the San Jacinto Mountains, the errors may be as large as 5 to 9 mGal. Errors resulting from elevation uncertainties are probably less than 0.5 mGal for most of the data because the majority of the stations are at or near bench marks, spot or 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 1.2 mGal. In general, the total uncertainties for the data shown on the map are estimated to be less than 5 mGal (or one contour interval), except in well-controlled areas where errors are less than 1-2 mGal.

Complete Bouguer gravity values range from -119.7 mGal in Coachella Valley near the town of Desert Hot Springs to 48.8 mGal in the southwest corner of the map. Gravity lows are generally located over sedimentary basins, such as the Los Angeles basin, Coachella Valley, Elsinore trough, and the San Jacinto valley, indicating accumulations of low-density material. Gravity highs are present over the offshore areas and outcrops of higher-density crystalline basement rocks of the western Peninsular Range. Bouguer gravity values gradually decrease eastward across the map, indicating that spatial variations in the Bouguer gravity field reflect not only the distribution of densities in the mid- to upper crust but also deep crustal and/or mantle sources.

REFERENCES

Blanck, E.L., Jr., 1987, Geologic structure of the Beaumont-Banning area, California from gravity profiles: Master of Science thesis, California State University, Los Angeles, 201 p.

Oliver, H.W., Chapman, R.H., Biehler, Shawn, Griscom, Andrew, Silver, E.A., Beyer, L.A., and Robbins, S.L., 1980, Gravity map of California and its continental margin: California Division of Mines and Geology Special Map, scale 1:750,000.

Plouff, Donald, 1977, Preliminary documentation for a FORTRAN program to compute gravity terrain corrections based on topography digitized on a geographic grid: U.S. Geological Survey Open-File Report 77-535, 45 p.

Sikora, R.F., Langenheim, V.E., Biehler, Shawn, Beyer, L.A., and Chapman, R.H., 1992, Principal facts for gravity data compiled for the Santa Ana 1° by 2° quadrangle, California: U.S. Geological Survey Open-File Report, in press.

Swick, C.H., 1942, Pendulum gravity measurements and isostatic reductions: U.S. Coast and Geodetic Survey Special Publication no. 232, 82 p.

Telford, W.M., Geldart, L.O., Sheriff, R.E., and Keyes, D.A., 1976, Applied Geophysics: New York, Cambridge University Press, 960 p.

Vedder, J.G., Beyer, L.A., Junger, A., Moore, G.W., Roberts, A.E., Taylor, J.C., and Wagner, H.C., 1974, Preliminary report on the geology of the continental borderland of southern California: U.S. Geological Survey Miscellaneous Field Investigations Map 624, 14 p., 9 plates.

Woollard, G.P., and Rose, J.C., 1963, International gravity measurements: Society of Exploration Geophysicists, Tulsa, OK, 518 p.