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BASE MAP FROM U.S. GEOLOGICAL SURVEY
TOPOGRAPHIC SERIES 1:100,000
SANTA ANA 1983

SCALE 1:100,000

NAUTICAL MILES

STATUTE MILES

KILOMETERS

TRUE NORTH

MAGNETIC NORTH

APPROXIMATE MEAN DECLINATION, 1990

Contour Interval of base is 50 meters

QUADRANGLE LOCATION

ISOSTATIC RESIDUAL GRAVITY MAP OF THE SANTA ANA 1:100,000-SCALE QUADRANGLE, CALIFORNIA

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EXPLANATION

Gravity anomaly contours. Contour interval 2 mGal. Hachures indicate gravity low. Contours were computer generated based on an 800 m by 800 m 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 obtained from Snyder and others (1982). Offshore stations provided by L.A. Beyer.

\+ Gravity station collected by the U.S. Geological Survey.

▲ Gravity station collected by the California Division of Mines and Geology.

▼ Gravity station obtained from the Defense Mapping Agency.

○ Gravity station obtained from A.G. Hull.

INTRODUCTION

The accompanying isostatic residual gravity map is part of the Southern California areal mapping project (SCAMP) and is intended to promote further understanding of the geology in the Santa Ana 1:100,000-scale quadrangle, California by serving as a basis for geophysical interpretations and by supporting both geological mapping and topical, SCAMP-related studies. Local spatial variations in the Earth's gravity field (after various corrections for elevation, terrain, and deep crustal structure explained below) reflect the distribution of densities in the mid- to upper crust. Densities often can be related to rock type and abrupt spatial changes in density commonly mark lithologic boundaries.

High-density basement rocks exposed within the Santa Ana quadrangle generally include metamorphic rocks and Mesozoic plutonic rocks present in the mountainous areas of the quadrangle. Plutonic bodies of mafic composition, such as gabbro or diorite, are usually responsible for gravity highs whereas felsic plutons where juxtaposed against denser metamorphic or igneous rocks may actually create local gravity lows. Alluvial sediments, usually located in the valleys, and Tertiary sedimentary rocks are characterized by low densities. However, with increasing depth and age, the densities of these rocks may become indistinguishable from those of basement rocks. Isostatic gravity values within the Santa Ana quadrangle range from about -48 mGal in the Los Angeles Basin to about 21 mGal near Bachelor Mountain in the southeastern part of the map.

DATA SOURCES, REDUCTIONS, AND ACCURACIES

Gravity data in the Santa Ana 1:100,000-scale quadrangle and vicinity were obtained from Snyder and others (1982a,b) and supplemented by 521 gravity stations obtained from A.G. Hull (written commun., 1991), 94 gravity stations from the Defense Mapping Agency (written commun., 1982), 521 gravity stations collected by the California Division of Mines and Geology and 166 U.S. Geological Survey stations. Offshore data were provided by L.A. Beyer (written commun., 1982) in the form of gridded gravity values derived from ship track lines. 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 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). An isostatic correction was then applied to remove the long-wavelength effect of deep crustal and/or upper mantle masses that isostatically support regional topography. The isostatic correction assumes an Airy-Heiskanen model (Heiskanen and Vening-Meinesz, 1958) of isostatic compensation; compensation is achieved by undulations of the model crust-mantle interface, with a sea-level crustal thickness of 25 km, a crust-mantle density contrast of 0.40 g/cm^3, and a crustal density of 2.67 g/cm^3 for the topographic load. These parameters were used because (1) they produce a model crustal geometry that agrees with seismically determined values of crustal thickness for central California, (2) changing the model parameters does not significantly affect the resulting isostatic anomaly (Jachens and Griscom, 1985) and (3) they are consistent with model parameters used for isostatic corrections computed for the rest of California (Roberts and others, 1990). The computer program ISOCOMP (Jachens and Roberts, 1981) directly calculates the attraction of an Airy-Heiskanen root by summing the attraction of individual mass prisms making up the root; the resulting isostatic residual gravity values should reflect lateral variations of density within the mid- to upper crust.

The main sources of error 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 (1.46 mGal) is about 0.1 mGal, but in the most rugged areas of the Santa Ana Mountains, the errors may be as large as 4 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 and spotand surveyed elevations, which are accurate to about 0.2 to 3 m. Measurements for which elevations were controlled by contour interpolationwould 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 2 mGal (or one contour interval).

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