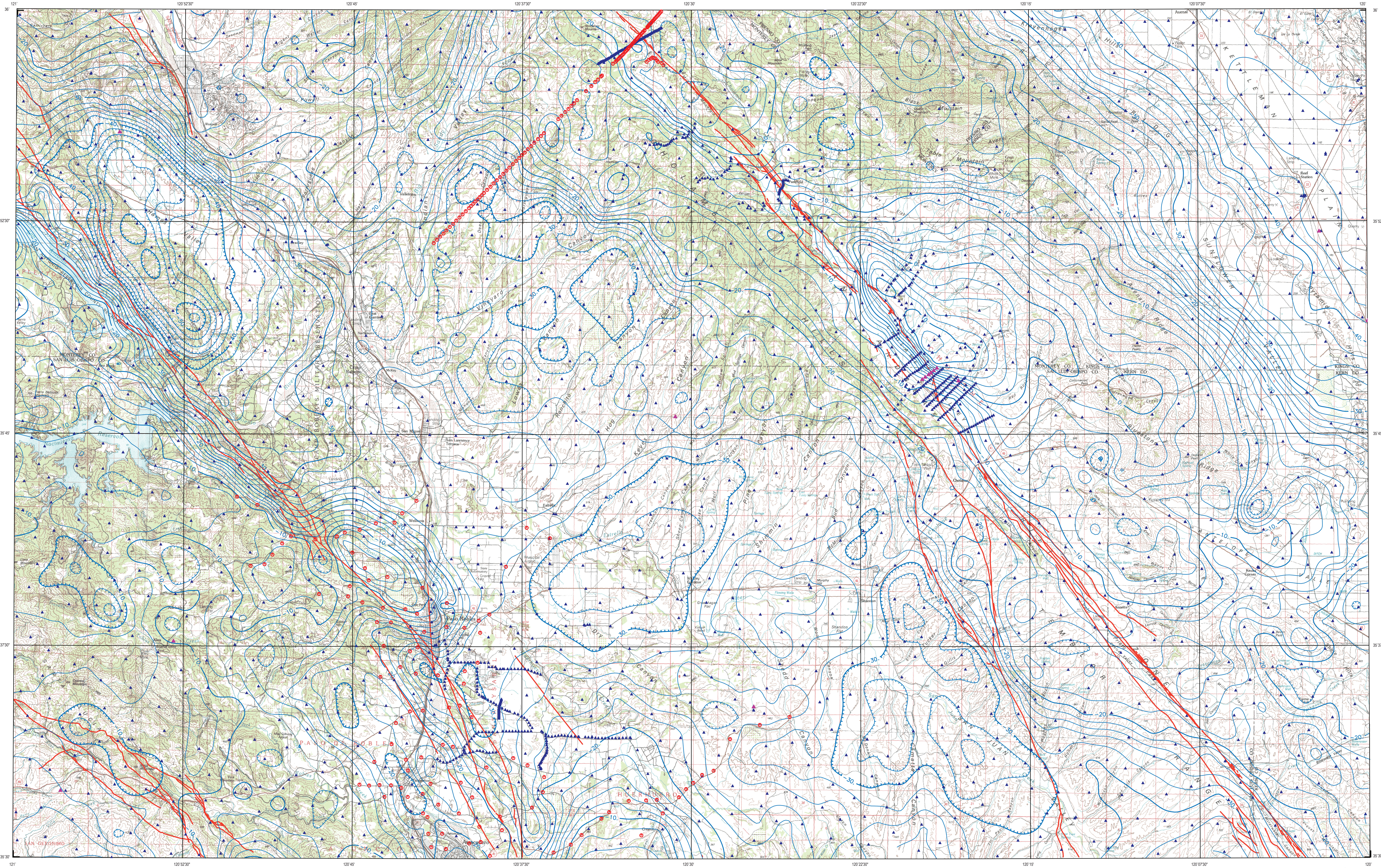

Base from U.S. Geological Survey
1:100,000 Paso Robles quadrangle (1989)
Universal Transverse Mercator, zone 10
1927 North American Datum
National Geodetic Vertical Datum of 1929

SCALE 1:100,000

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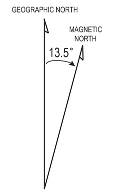

Preliminary Isostatic Residual Gravity Anomaly Map of Paso Robles 30 X 60 Minute Quadrangle, California

By
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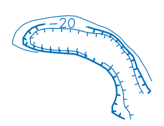
MAP EXPLANATION



Contours of isostatic residual gravity. Contour interval is 2 mGal. Hachures indicate closed gravity lows.

▲ Gravity station location of previously published data (Burch and others, 1971; Campion and others, 1983; Defense Mapping Agency)

▲ Gravity station location of data from the PACES database (Pan-American Center for Earth and Environmental Studies, 2010)

Gravity station location of newly acquired data from the U.S. Geological Survey, 2003-2010

Faults (Jennings and others, 1977)

INTRODUCTION

This isostatic residual gravity map is part of an effort to map the three-dimensional distribution of rocks in the central California Coast Ranges and will serve as a basis for modeling the shape of basins and for determining the location and geometry of faults within the Paso Robles quadrangle. Local spatial variations in the Earth's gravity field, after accounting for variations caused by elevation, terrain, and deep crustal structure 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 lithological or structural boundaries. High-density rocks exposed within the central Coast Ranges include Mesozoic granitic rocks (exposed northwest of Paso Robles), Jurassic to Cretaceous marine strata of the Great Valley Sequence (exposed primarily northeast of the San Andreas fault), and Mesozoic sedimentary and volcanic rocks of the Franciscan Complex [exposed in the Santa Lucia Range and northeast of the San Andreas fault (SAF) near Parkfield, California]. Alluvial sediments and Tertiary sedimentary rocks are characterized by low densities; however, with increasing depth of burial and age, the densities of these rocks may become indistinguishable from those of older basement rocks.

ACKNOWLEDGMENTS

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GRAVITY DATA

The isostatic residual gravity map was created from 2,604 gravity measurements. A new dataset, comprised of 170 stations, was collected by the U.S. Geological Survey (USGS) between 2003 and 2010. Previously published data include 14 stations from a database from the Pan-American Center for Earth and Environmental Studies (PACES, 2010) and a compilation of older published data (2,420 stations) from various sources, including Burch and others (1971), Campion and others (1983), and the Defense Mapping Agency. Gravity stations are nonuniformly distributed throughout the region with station spacing, on average, of 1 station per 1.6 km^2. Detailed NE-SW profiles across the SAF, particularly near Parkfield, California, supported geophysical studies along the fault in this region. In addition, detailed profiles and more densely spaced gravity stations were collected in and around the city of Paso Robles in order to more closely investigate fault geometry and geothermal resources in the area (Campion and others, 1983).

Observed gravity values were based on a time-dependent linear drift between successive base readings and were referenced to the International Gravity Standardization Net 1971 gravity datum (Morelli, 1974). Free-air gravity anomalies were calculated using the Geodetic Reference System 1967 formula for theoretical gravity on the ellipsoid (International Association of Geodesy and Geophysics, 1971) and standard formulas for the free-air correction (Blakely, 1995). Bouguer, curvature, and terrain corrections to a radial distance of 166.7 km were applied to the free-air anomaly at each station to determine the complete Bouguer gravity anomalies at a standard reduction density of 2,670kg/m^3 (Plouff, 1977). Finally, an isostatic correction was applied to remove the long-wavelength effect of deep crustal and/or upper mantle masses that isostatically support regional topography. The isostatic gravity field was removed from the Bouguer field assuming an Airy-Heiskanen model for isostatic compensation of topographic loads (Jachens and Roberts, 1981) with an assumed normal sea-level crustal thickness of 25 km, a crust-mantle density contrast of 400 kg/m^3, and a crustal density of 2,670 kg/m^3 for the topographic load. The resulting isostatic residual anomaly reflects lateral variations of density within the mid- to upper crust. Gravity values are expressed in mGal (milligal), a unit of acceleration or gravitational force per mass equal to 10^{-5} m/s^2. For the newly collected data (2003-2010), elevations were known to ±1 m, yielding an uncertainty due to elevation in the anomaly value of ±0.2 mGal.

New gravity data were combined with pre-existing data within the quadrangle. Terrain corrections and gravity anomalies were recomputed using standard formulas and programs, described above, for gravity data from the PACES database. Some gravity data were discarded because of incorrect locations, elevations, or gravity values determined by visual inspection and comparisons with adjacent or duplicate stations. All gravity data were gridded using a minimum curvature algorithm at an interval of 400 m and displayed at a 2 mGal contour interval. Gravity station names, locations, and values can be found in appendix 1.

DISCUSSION

Gravity anomaly values within the Paso Robles quadrangle span a range of almost 70 mGal, from the highest value of about 13 mGal northeast of the SAF immediately south of Table Mountain (fig. 1) to the lowest value of -53 mGal in the northwest corner of the quadrangle near Hames Valley (fig. 1). In some areas, sharp gravity gradients reflect contrasting geology across faults. For example, the SAF juxtaposes Salinian granitic basement on the southwest against Franciscan Complex on the northeast and gives rise to a gravity gradient as large as 16 mGal/km in some areas within the quadrangle. The highest gravity anomaly values in this area, immediately northeast of the SAF, are caused by blocks of dense Permanente terrane (composed of limestone and greenstone; McPhee and others, 2004). Gravity anomaly values decrease to the northwest of the Permanente terrane due to less dense serpentinite embedded in the Franciscan Complex rocks. Anomaly values drop even further in the far northeast corner of the quadrangle as the sediments thicken toward the Great Valley.

Moderate gravity maxima observed southwest of the SAF likely are caused by the variable thickness of Cenozoic deposits overlying the buried granitic basement rocks. A sharp gravity gradient (~12 mGal/km) across the Rinconada Fault (fig. 1) separates granitic basement rocks on the southwest from Hames Valley and less dense sediments on the northeast. Anomaly maxima in the southwest corner of the quadrangle reflect dense basement rocks of the Santa Lucia Range and surrounding mountains.

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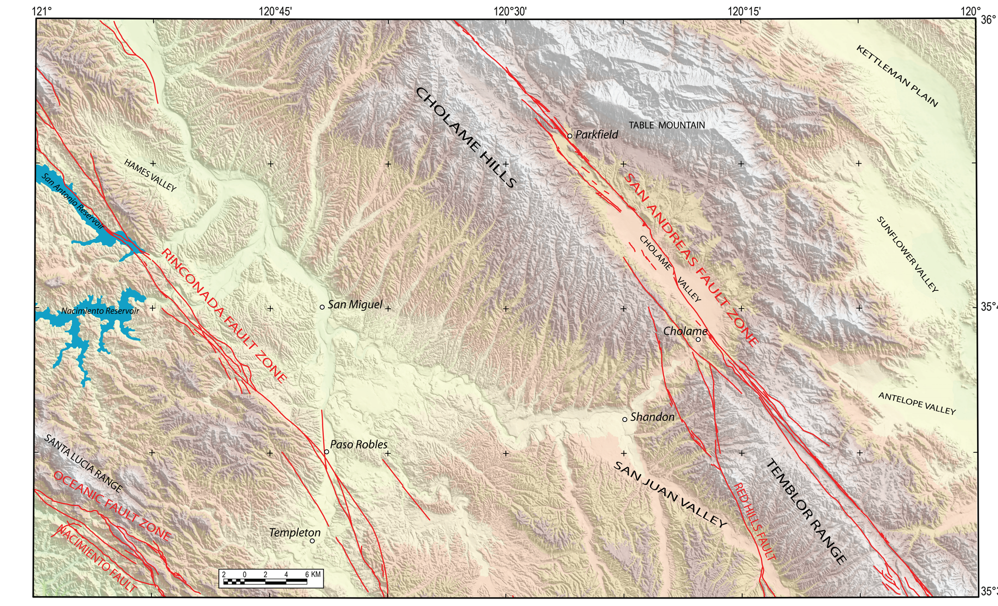

Figure 1. Shaded-relief map showing geographic features and major faults (red lines; Jennings and others, 1977).

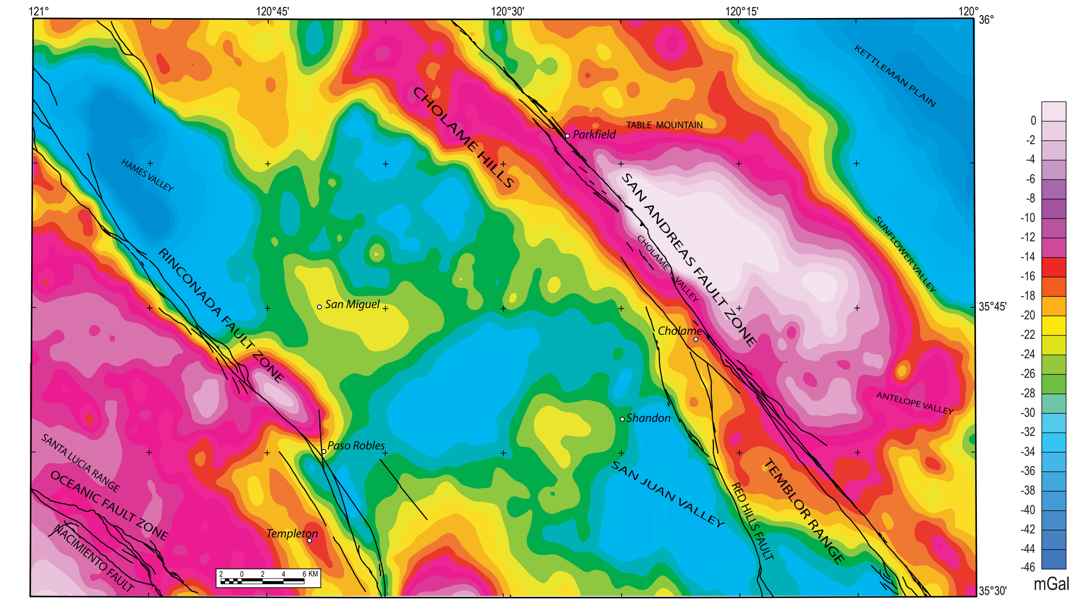

Figure 2. Color-contour isostatic residual gravity map with major faults (black lines; Jennings and others, 1977).

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