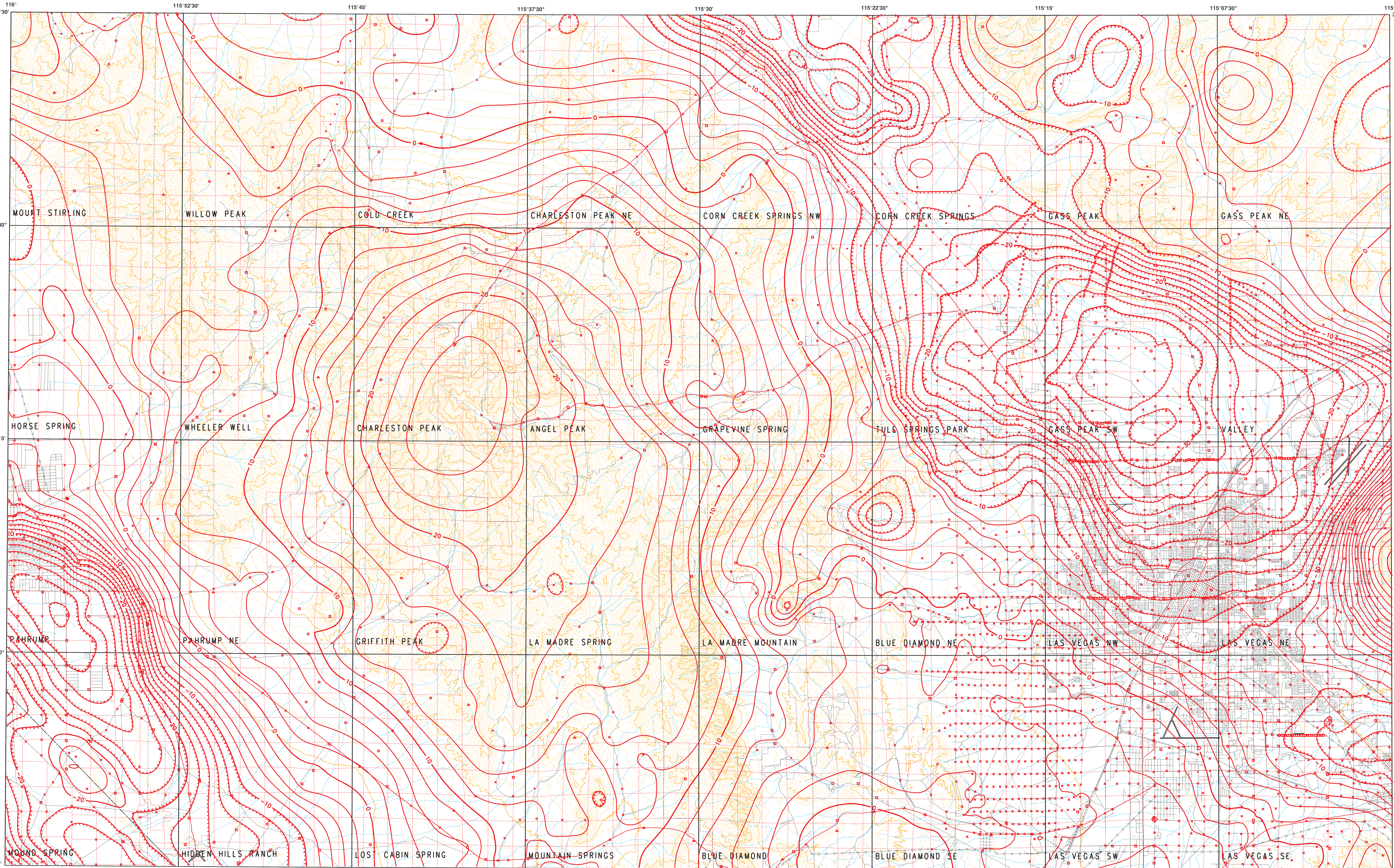
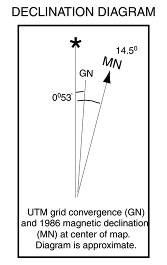
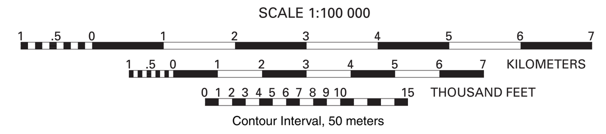
OPEN-FILE REPORT 99-398
Version 1.0



Base map prepared by the U.S. Geological Survey (1986) at 1:100,000. Universal Transverse Mercator projection.





ISOSTATIC GRAVITY MAP OF THE LAS VEGAS 30 x 60 MINUTE QUADRANGLE, CALIFORNIA AND NEVADA

By
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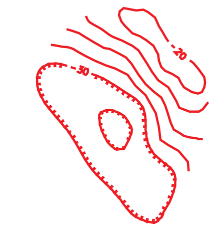
1999

INDEX MAP

EXPLANATION



Gravity anomaly contours. Contour interval, 2 mGal. Hachures indicate gravity low. Contours were computer-generated based on a 300-m grid. Although the data have been edited, caution should be exercised when interpreting anomalies controlled by only a single gravity station.

- Defense Mapping Agency station
- U.S. Geological Survey 1980's
- U.S. Geological Survey 1995-1998
- Kane and others, 1979
- Contractor, 1999

Introduction

This isostatic residual gravity map is part of the Las Vegas Urban Corridor mapping project and is intended to promote further understanding of the geology in the Las Vegas 30 x 60 minute quadrangle, Nevada, by serving as a basis for geophysical interpretations and by supporting both geological mapping and topical (i.e., hydrologic) 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 relate to rock type, and abrupt spatial changes in density commonly mark lithologic boundaries.

Basement rocks exposed within the Las Vegas quadrangle include Paleozoic carbonate and siliciclastic rocks exposed in the mountainous areas of the quadrangle and produce many of the positive anomalies. The highest densities measured on the Las Vegas quadrangle are from Precambrian gneiss exposed on the western edge of Frenchman Mountain (latitude 36°11'N, longitude 115°01'W) and Paleozoic dolomites exposed in the Spring Mountains (Langenheim and others, 1998). Alluvial sediments, usually located in the valleys, and Tertiary sedimentary and volcanic 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 basement rocks.

Isostatic residual gravity values within the Las Vegas quadrangle range from about -33 mGal over the sedimentary basins of the Las Vegas (centered over the Gass Peak SW quadrangle) and Pahrump (southwest corner of quadrangle) Valleys to about +25 mGal near Mt. Charleston in the west-central part of the map.

Data Sources, Reductions, and Accuracies

Gravity data in the Las Vegas 1:100,000-scale quadrangle and vicinity include 1815 gravity stations obtained by the U.S. Geological Survey from October 1995 to June, 1998, 423 gravity stations from the Defense Mapping Agency (National Geophysical Data Center, 1994), and 159 stations from Kane and others' (1979) compilation for the Bouguer gravity map of the Las Vegas 1° by 2° quadrangle. An additional 42 gravity stations are from a U.S. Geological Survey effort in the late 1980's and 67 stations collected by contract in the spring of 1999. More detailed information on recent U.S. Geological Survey data collection is contained in Langenheim and others (1998) and Morin and others (1999). Figures 1 and 2 show how the increased gravity coverage has improved the definition of anomalies, especially in Las Vegas and Pahrumps Valleys. 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 Union of Geodesy and Geophysics, 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. 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 varying the depth of the model crust-mantle interface, using the following parameters: 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 are consistent with model parameters used for isostatic corrections computed for nearby California (Roberts and others, 1990), and (2) changing the model parameters does not significantly affect the resulting isostatic anomaly (Simpson and others, 1986). 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 and thus calculating the isostatic correction; the resulting isostatic residual gravity values should reflect lateral variations of density within the middle to upper crust.

The main sources of error are inaccurate elevations and tterrain corrections. Errors associated with terrain corrections may be 5 to 10 percent of the value of the total terrain correction. The error based on the average terrain correction (1.91 mGal) is thus about 0.2 mGal, but in the most rugged areas of the Spring Mountains, the individual 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 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 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), although in many areas the data are considerably more accurate.

Acknowledgments

We would like to thank the Southern Nevada Water Authority and the Las Vegas Valley water district for financial and logistical support for many of the gravity stations in the eastern two-thirds of the quadrangle. We also would like to thank the Nye County Nuclear Waste Project Office in Pahrump for financial support for stations collected in Pahrump Valley. The map benefited from reviews by David Ponce and Carter Roberts (U.S. Geological Survey, Menlo Park, Calif.).

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BEFORE

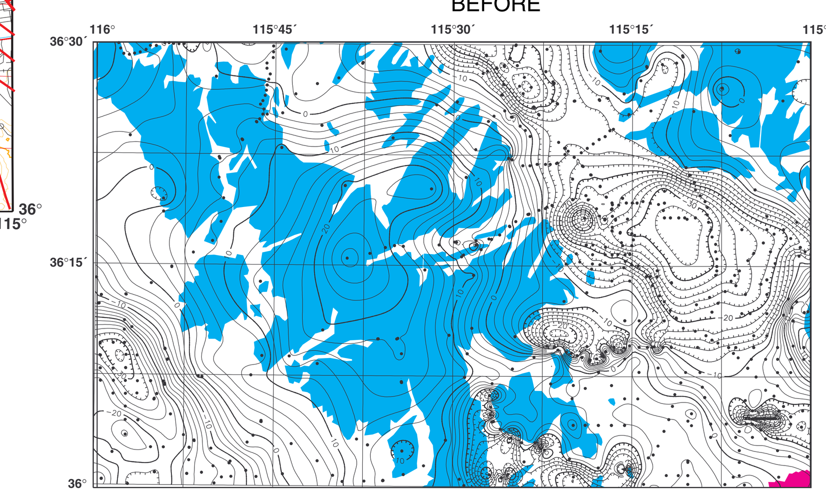

Figure 1. Blue, pre-Cenozoic rocks; magenta, Cenozoic volcanic rocks. 759 gravity stations from Saltus (1988).

AFTER

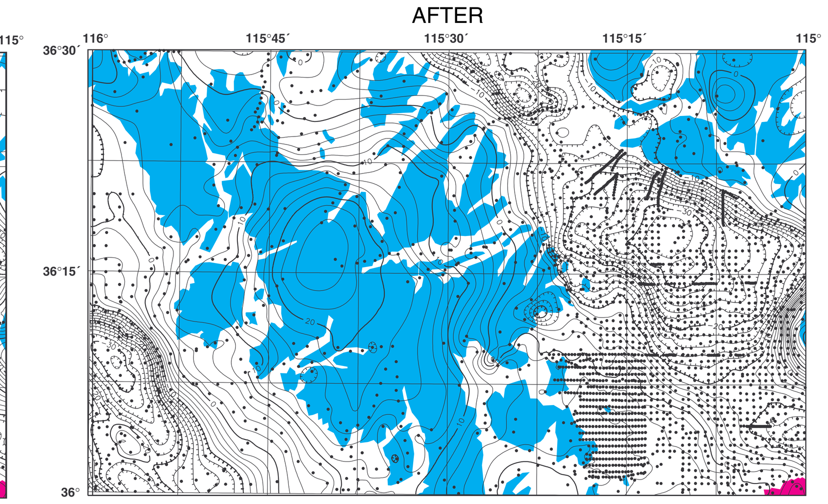

Figure 2. Blue, pre-Cenozoic rocks; magenta, Cenozoic volcanic rocks. 2508 gravity stations.

This report is preliminary and has not been reviewed for conformity with U.S. Geological Survey editorial standards or with the North American Stratigraphic Code. Any use of trade, firm or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government.